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SYMPOSIUM ON GASTROINTESTINAL SURGERY

THE SURGICAL TREATMENT OF PEPTIC ULCER

GEORGE CRILE, JR., M.D., F.A.C.S.

GASTRIC ulcer and duodenal ulcer are different diseases which have different consequences and require different treatments. The oversecretion of hydrochloric acid seems to play a more important role in duodenal ulcer than in gastric ulcer; the acidity of the gastric juice may be normal or even low in gastric ulcer. After a gastric resection for gastric ulcer there is little or no tendency for ulceration to occur in the jejunum. Gastric ulcer attacks people of an older age group than those affected by duodenal ulcer. It is often impossible to differentiate between a benign gastric ulcer and an ulcerating carcinoma; in fact, in some instances carcinoma may originate in a benign gastric ulcer. For these reasons the treatment of gastric ulcer is primarily a surgical problem, involving excision of a potential cancer, whereas the treatment of duodenal ulcer is essentially a medical problem and requires operation only when the symptoms are rendered intractable by complications.

The results of gastric resection for duodenal ulcer have left much to be desired. If most of the stomach is removed the patients often fail to regain their weight and strength or suffer from sensations of weakness and fullness or distress when they eat (dump syndrome). When less radical resections are performed, and even when most of the stomach is removed, the ulcer recurs at the site of the anastomosis in about 6 per cent of the cases. Moreover, the mortality rate of gastric resection for duodenal ulcer is increased by the difficulties encountered in removing the ulcer and effecting a good closure of the duodenal stump without injuring the common bile duct.

The results of gastric resection for gastric ulcer are excellent. There is

From the Cleveland Clinic, Cleveland, Ohio

no problem of closing the duodenal stump, and the later complication of marginal ulcer is exceedingly rare. The resections need not be so radical as in duodenal ulcer unless the ulcer is located very high. Hence the mortality and the morbidity rates are low

High gastric ulcers originating a centimeter or two from the esophagus present a different problem In some cases no less radical a procedure than total gastrectomy can remove the ulcer In the very high ulcers it is questionable whether this risk of mortality and morbidity is justified when more conservative procedures, such as biopsy of the ulcer coupled with gastroenterostomy or gastroenterostomy and vagotomy, are effective.

TREATMENT OF GASTRIC ULCER

Indications for Operation.—Since gastric ulcers cannot always be differentiated from gastric carcinomas by x-ray examination, by gastroscopy, by analysis of clinical data, or even at the time of operation, the treatment is primarily surgical By this it is not implied that all gastric ulcers should be resected as soon as the diagnosis is made, without a trial of medical therapy, but certainly all large gastric ulcers, all recurrent gastric ulcers, and all gastric ulcers which persist in spite of an adequate trial of a month of medical treatment should be resected unless there are strong contraindications. The criteria of healing are failure of the roentgenologic or gastroscopic examination to demonstrate an ulcer, complete subsidence of symptoms and disappearance of blood from the stool

Choice of Operation.—Gastric resection is the treatment of choice for the average gastric ulcer occurring in the pylorus, antrum, or pars media of the stomach. Since there is almost no tendency for marginal ulcers to develop after operations for gastric ulcer, there is no need to perform a vagotomy unless the values of free acid are unusually high. When the ulcer is located so high that it could not be resected without removing all or most of the stomach, a satisfactory result can be obtained by vagotomy. It is essential that a biopsy be made to rule out malignancy. This can be done with a biopsy forceps through a gastroenterostomy stoma, even when the ulcer is high, and by gastrotomy if a gastroenterostomy is not performed.

A third procedure well adapted to the treatment of small ulcers is vagotomy, excision of the ulcer and gastroenterostomy. When the ulcer lies on the anterior or posterior wall its excision does not disturb the motility of the stomach and it is not necessary to perform a gastroenterostomy. When the ulcer is on the lesser curvature or when it is necessary to remove any part of the lesser curvature, the emptying of the stomach may be delayed and a gastroenterostomy should be performed.

Vagotomy alone without resection, excision, or at least biopsy of a gastric ulcer should not be employed because of the danger that carcinoma might be present.

TREATMENT OF DUODENAL ULCER

The subject of the treatment of intractable duodenal ulcer is controversial. Some still believe that radical gastric resection is the treatment of choice, whereas others prefer the more conservative procedure of vagotomy combined with pyloroplasty or gastroenterostomy. Our reasons for preferring transabdominal vagotomy, coupled with a conservative operation to afford drainage of the denervated stomach, are based on an experience of only two and one-half years, but since the initial results following vagotomy have been superior to those obtained by any other method of treatment we believe that we are justified in resorting to this operation when medical treatment proves ineffective.

About 85 per cent of the patients we see with duodenal ulcer make satisfactory progress on medical management. The patients who are being subjected to vagotomy are those with intractable complications of duodenal ulcer which require surgical intervention. Since transabdominal vagotomy has proved safer and more effective than gastric resection and since removal of three fourths or more of the stomach is an irreversible procedure which cannot be altered even it it produces incapacitating symptoms, it would appear that vagotomy is the conservative method of treatment and that gastric resection is unnecessarily radical.

Duodenal ulcer is a disease which causes much distress but rarely threatens life except in the case of perforation. Since it is not a disease which carries with it a high mortality rate, operations which entail a significant risk and a high morbidity are not justified in its treatment.

In spite of the fact that in the past ten years at the Cleveland Clinic the mortality rate of gastric resection for duodenal ulcer has been only 2.8 per cent, we have felt that any mortality incurred in the treatment of a disease which does not directly threaten the life of the patient is an irreparable tragedy. We therefore welcomed transabdominal vagotomy as a procedure which entails a minimal risk and which, over a period of more than two years in our hands and of five years in the experience of Dr. Lester Dragstedt, has afforded the best protection against recurrence of ulcer.

Transabdominal vagotomy has now been performed by Dr. T. E. Jones and myself 228 times with four deaths. One patient died as a result of perforation of the ulcer, which occurred three days after operation. One obese patient died on the fourth postoperative day, and autopsy revealed no cause for death; examination of the brain was not permitted.

One patient who was obese and whose esophagus was isolated to aid in identification of the nerves died of mediastinitis from perforation of the esophagus. The mortality rate of vagotomy in 227 consecutive cases is thus 1 3 per cent. A fourth death has occurred in the hospital after vagotomy, but it hardly seems fair to attribute it to the operation The patient was exsanguinated and pulseless at the time of operation The bleeding point was ligated and the vagus nerves resected Convalescence was uneventful, and the patient was dressed and on the point of going home when he developed chills and fever. Following this he had another massive hemorrhage from the ulcer A second operation was performed, the bleeding point was again ligated, the duodenum was excluded by infolding the pylorus, and a gastroenterostomy was done The patient expired several days after the second operation Autopsy showed both lungs to be consolidated in what appeared to be an extensive virus pneumonia. If this death, occurring in a patient subjected to an emergency operation, is included, the mortality rate is 1 8 per cent Dragstedt has performed approximately 300 transabdominal vagotomies with "no deaths attributable to the procedure "[2] Most of the reported complications and deaths have followed transthoracic vagotomy, an operation which we have now abandoned because the stomach can nearly always be denervated as well by the transabdominal approach.

It is true that our period of observation has been too short to permit final evaluation of the method. Nevertheless, it is already apparent to us that in the first two and one-half years after operation, vagotomy accompanied by gastroenterostomy or pyloroplasty is (1) safer than gastric resection, (2) more effective than gastric resection in controlling recurrent ulceration, and (3) preferable to gastric resection because its morbidity is lower and it is more effective in restoring the patient to health and normal activity.[3]

The gratifying initial results obtained in our first 50 vagotomies for peptic ulcer (gastric, jejunal and duodenal) have been reported by Collins and Stevenson [4] As time passes these results become even more gratifying. There have been no late recurrences of symptoms due to ulcer.

Comparison of Results of Vagotomy with Other Methods of Treatment.—The course of fifty consecutive patients during the first year

[illegible]

cations which occurred over a year after resection were disregarded so that the time interval of the studies would be comparable. All patients were followed for at least four months. The results were graded as follows:

Excellent—no significant gastrointestinal symptoms; patient well and working.

Improved—persistent gastrointestinal symptoms requiring intermittent or constant dietary and medical treatment.

Failure—uncontrollable symptoms as severe as before operation.

Three of the six patients classified as failures following gastric resection developed demonstrable jejunal ulcers in the first year. The other three developed symptoms typical of jejunal ulcer, but the ulcer could not be demonstrated.

TABLE 1

COMPARISON OF RESULTS OF OPERATION

	Mortality (per cent)	Not Followed (per cent)	Followed Survivors		
			Excellent (per cent)	Improved (per cent)	Failure (per cent)
Gastric resection—50 cases	4*	6	58	29	13
Gastroenterostomy—50 cases		10	53	33	14
Vagotomy—50 cases (13 had vagotomies only, 30 had gastroenterostomies, 7 had pyloroplasties)	0†	0	88	10	2

* In the larger group of 140 cases the mortality was 2 8 per cent.

† In the larger group of 228 cases the mortality was 1 3 per cent.

The patient who is classified as a failure following vagotomy was subjected to vagotomy alone without any complementary operation to facilitate emptying of the denervated stomach. Three months later, because of persistent symptoms referable to gastric retention, a gastroenterostomy was performed.

The complaints of the thirteen patients who continued to have symptoms after gastric resection alone but who were classified as improved were as follows:

Two had pain similar to preoperative pain.

Two had pain, vomited, and were losing weight.

Two vomited after meals.

Two had persistent nausea.

One had vague gastrointestinal symptoms and subsequently died of appendicitis.

One had a hemorrhage from the stomach and suffered from bloating.

One had pain and a hemorrhage
One had a bad taste in mouth and poor appetite
One was weak and did not gain weight

The complaints of the five patients who continue to have symptoms after vagotomy but who are classified as improved are as follows

Two have diarrhea and bloating after meals but are improving steadily four months after operation
One has gas, belching and mild diarrhea but considers his condition *much better than before operation*
One has nausea, weakness and intermittent diarrhea
One experiences persistent ulcer-like symptoms, although no ulcer can be demonstrated by roentgenogram This patient had a very small posterior vagus trunk, and it is probable that the denervation was incomplete. The symptoms are controlled by medical management

Three of the six patients who failed to obtain excellent results were subjected to vagotomy alone, without pyloroplasty or gastroenterostomy. *These patients developed symptoms referable to gastric retention, but* they are improving with the passing of time. In none of these except the one who required a secondary gastroenterostomy has the retention incapacitated the patient or proved to be more than an inconvenience and embarrassment Nevertheless, my personal preference is for the routine employment of pyloroplasty or gastroenterostomy, the choice of operation depending on the amount of fixation and scarring of the duodenum

None of the patients in this series has taken antacids or followed a diet other than the bland diet prescribed for the first six weeks after operation Smoking and alcohol have not been interdicted. This is in sharp contrast to the management of patients subjected to gastric resection, most of whom were advised to maintain a full medical regimen of antacids and diet and to eliminate tobacco and alcohol.

In addition to the five patients who have symptoms of sufficient significance to warrant treatment, there are eleven others (22 per cent) who have symptoms so mild that they do not require treatment, do not interfere with normal activities, and are elicited only in response to the promptings of *a questionnaire. On the basis of the patient's own evaluation* and of the patient's ability to return to normal activity without medical management, the results in these cases have been classified as excellent.

Four have occasional gas pains
Two are constipated (one has a feeling of fullness when bowels do not move, the other a slight gas pain)

One has occasional diarrhea.
One has stools which are watery but not frequent (only one or two a day).
One has occasional belching of foul gas.
One has occasional pain on right side.
One has diarrhea and gas pain after eating fresh fruit.

Since the majority of patients who develop marginal ulcers have symptoms or demonstrable ulcers in the first year after operation,[4] these figures, although admittedly covering only a brief period, probably are significant. In any case, they indicate that the mortality and morbidity in the first year after vagotomy, alone in selected cases or more often in conjunction with pyloroplasty or gastroenterostomy, is much lower than that following gastric resection.

The results following gastroenterostomy alone have been as unsatisfactory as are those following resection. The incidence of marginal ulcer and of persistent symptoms requiring medical treatment in a series of fifty consecutive cases was higher in the first year than was observed in patients subjected to gastric resection. It is clear, therefore, that the gastroenterostomies and pyloroplasties that were commonly performed in conjunction with a vagotomy cannot be given too much credit for the results obtained in this series of cases.

Even those who most strongly oppose the use of vagotomy in the treatment of peptic ulcer do so because they fear that vagotomy will not afford permanent protection against recurrent ulceration rather than because they fear the end results of sectioning of the vagus nerve.[5] They combine vagotomy with gastric resection in the treatment of duodenal ulcer and in so doing accept the additional hazard of resection. This is in spite of the experience of Dragstedt, who has performed vagotomy alone or with gastroenterostomy and has followed his patients for four years or more without observing recurrences in patients whose stomachs have been completely denervated.

Since it appears that the mortality rate of gastroenterostomy and vagotomy will be lower than that of resection in the hands of the same surgeon, the burden of proof rests upon him who accepts the responsibility of employing an operation which entails a greater risk and whose immediate results are not so satisfactory as are those which follow the safer procedure. And always, regardless of the apparent safety of transabdominal vagotomy, it should be emphasized that any operation entails risk, that duodenal ulcer is rarely a fatal disease, and that the risk of even so safe a procedure as vagotomy should not be undertaken until a fair trial has been given to medical treatment.

JEJUNAL ULCER

If no obstruction is demonstrable by x-ray examination, transabdominal vagotomy is the preferred treatment for jejunal ulcer If obstruction is present a vagotomy should be performed, the old gastroenterostomy taken down and a new one made. The results in a series of seventeen cases treated in this manner have been excellent, and there have been no recurrences of symptoms The patients have been followed from one to twenty-eight months after operation

TECHNIC OF VAGOTOMY

Transabdominal vs. Transthoracic Vagotomy.—Transabdominal vagotomy has supplanted the transthoracic approach because (1) the abdominal approach allows examination of the ulcer and concomitant abdominal disease, such as gallstones, (2) the abdominal approach enables the surgeon simultaneously to perform some type of operation such as gastroenterostomy or pyloroplasty so that the hypomotility resulting from vagotomy will not result in gastric retention, (3) the abdominal approach is probably safer than the transthoracic; (4) the scar left by the abdominal incision is less troublesome than the intercostal, where neuralgia sometimes follows resection of a rib; (5) anatomic studies have shown that subdiaphragmatic vagotomy usually can be as complete and effective as transthoracic, (6) the results of subdiaphragmatic vagotomy, as indicated by the clinical course of the patients, are comparable to those following the transthoracic approach

Surgical Anatomy of the Vagus.—Anatomic studies of the vagus indicate that in the majority of cases the vagi form two large trunks above the diaphragm and descend through the esophageal hiatus in the form of two large nerves Sometimes the main trunks are formed at or even below the level of the diaphragm, and sometimes one or two small branches are given off above the diaphragm and descend through the hiatus with the main trunks The anterior or left vagus is usually the smaller of the two and is about the size of the lead of a lead pencil. The posterior, or right vagus, is often one and one-half to two times as large

The anterior vagus lies just below the peritoneum near the midline of the esophagus. The posterior vagus has a more variable position but usually lies behind the middle of the esophagus or slightly to the right Its relationship to the wall of the esophagus is not so intimate as that of the anterior vagus, and it lies in the loose areolar tissue of the posterior abdominal wall more often than in or on the musculature of the esoph-

[illegible] vagus given off

[illegible] rves do not give

[illegible] the stomach

Preparation for Operation.—Either general anesthesia or a high spinal anesthetic supplemented by pentothal may be used.

The stomach should be emptied by gastric suction and a Levine tube left in place to aid in identifying the esophagus.

Exposure.—A midline incision is not only less vascular and easier to open and close than a left rectus incision, but it also affords a higher and hence a better exposure. It extends from the umbilicus to the xiphoid (Fig. 316).

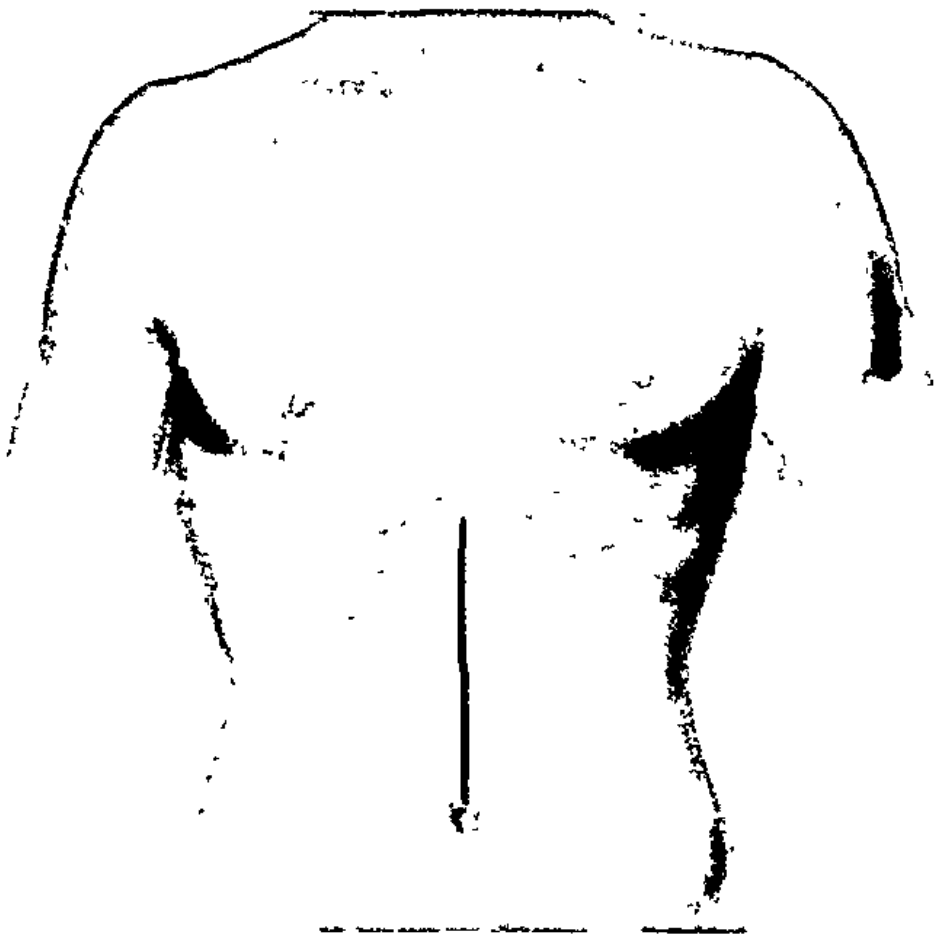

FIG 316.—Midline incision xiphoid to umbilicus

Before proceeding with vagotomy the abdomen should be explored, and the surgeon should examine the stomach, duodenum, gallbladder and esophageal hiatus. It is unwise to perform a gastric operation before vagotomy because soiling from the gastric operation results in contamination of the vulnerable mediastinum and subdiaphragmatic space during the vagotomy. Moreover, if for some reason a satisfactory vagotomy cannot be accomplished, it is possible that the surgeon would elect a radical rather than a conservative gastric operation.

The left lobe of the liver does not interfere with exposure of the vagus.

In several of the earlier cases it seemed desirable to divide the avascular diaphragmatic attachments of the left lobe of the liver and reflect it to the right to obtain better exposure of the diaphragm With increasing experience this maneuver has not been necessary A broad Deaver or malleable retractor inserted under the liver to lift it forward affords adequate exposure

FIG. 317.—Locating anterior vagus nerve Stomach is pulled downward, stretching *elastic tissues of peritoneum and esophagus Vagus is not elastic, becomes taut as a violin* string, is easily palpable Peritoneum is incised, and nerve is picked up on a nerve hook

Identification of the Vagus.—The anterior vagus is quite constant in its location and usually can be found with little or no difficulty. The surgeon stands on the right side of the table. The stomach is grasped in the right hand with a moist tape and retracted downward, while an assistant retracts the liver anteriorly with a Deaver retractor to expose the lower part of the esophagus By palpation with the left hand the operator can identify the Levine tube in the esophagus Firm downward traction is then exerted on the stomach in such a way that the esophagus is stretched. The musculature of the esophagus, the peritoneum reflecting

from the stomach and the esophagus on to the diaphragm, and the blood vessels of the stomach and esophagus are elastic, whereas the vagus nerve is nonelastic and stands out like a violin string, palpable and often visible beneath the peritoneum. As soon as the nerve is identified by palpation with index finger of the left hand, the traction on the stomach is delegated to an assistant who maintains it while the peritoneum overlying the nerve is incised and the nerve is picked up on a long nerve hook

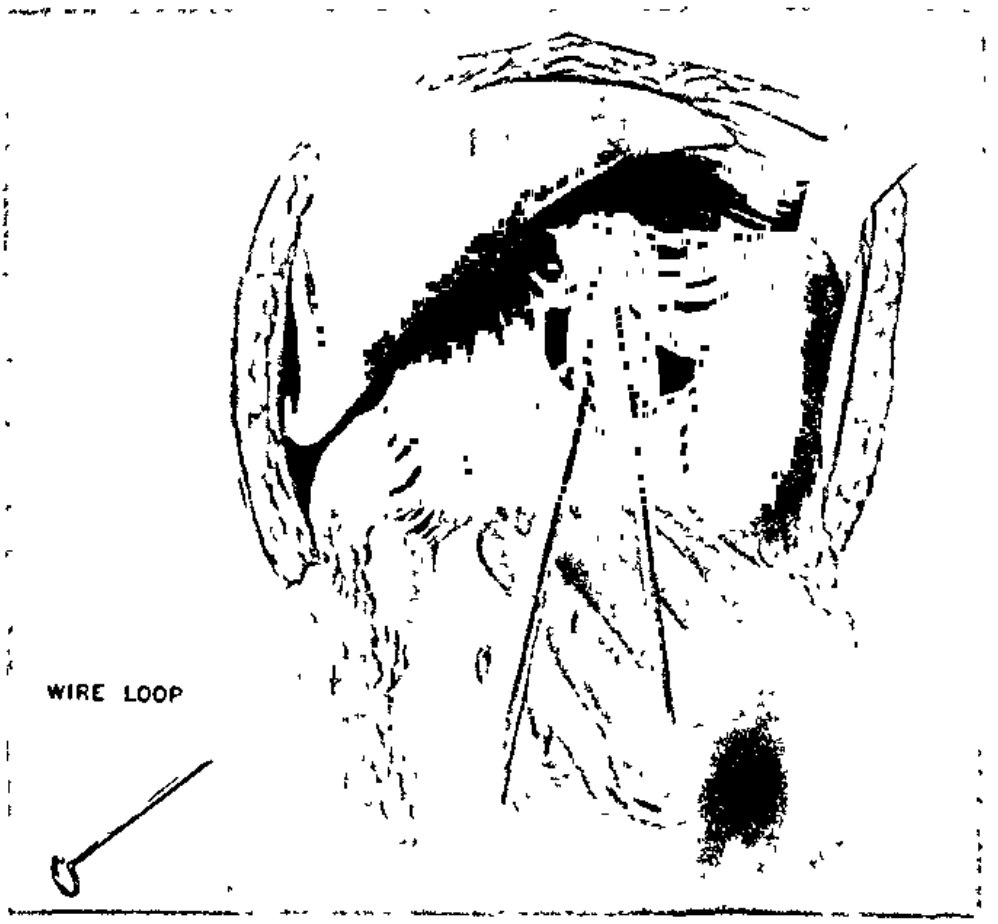

FIG. 318.—Stripping vagus nerve. A wire loop is placed over vagus and is thrust upward into mediastinum to strip small fibers from main trunk.

Its identity is quite unmistakable, and as soon as it is isolated it can be proved to be the vagus by following it upward through the esophageal hiatus in the diaphragm. The blood vessels of the stomach do not course in this direction nor does the esophageal hiatus transmit any other structure from the thorax to the abdomen (Fig. 317).

The nerve is isolated by blunt dissection with a special instrument which is passed through the diaphragm and preferably higher so that there will be no question of failure to remove all accessible branches (Fig. 318). The nerve is then clamped with a Moynihan clamp, divided,

and again divided several centimeters lower. The excised segment 2 to 5 cm. in length is examined by the pathologist to prove its identity

After completion of the anterior vagotomy the forefinger of the left hand is inserted through the delicate peritoneum of the gastrohepatic omentum above the gastric vessels, as in mobilization of the stomach for total gastrectomy The stomach is again pulled downward by the right hand, and the posterior vagus is located by palpation as a tense cord

FIG. 319.—Locating posterior vagus nerve. Posterior vagus usually lies behind and to the right of esophagus, is often well away from esophagus Downward traction is exerted on stomach, and posterior vagus is located by palpation

lying posterior to the esophagus in the areolar tissue Occasionally it appears to be more to the right of the esophagus than directly posterior and may be surprisingly far away from it. While an assistant pulls the

of its branches a segment of the nerve is removed, as in the anterior vagotomy (Fig. 319). A final examination of the esophagus should be made to exclude the presence of additional branches coming down from above the diaphragm. It is not necessary to reconstruct the peritoneum.

Attention is next directed to whatever operation on the stomach is desirable to prevent gastric retention. Pyloroplasty, gastric resection, gastroenterostomy and local excision of the ulcer each has its place, and the selection must depend on the size of the ulcer, its location, the amount of obstruction, the completeness of the vagotomy and on the preferences

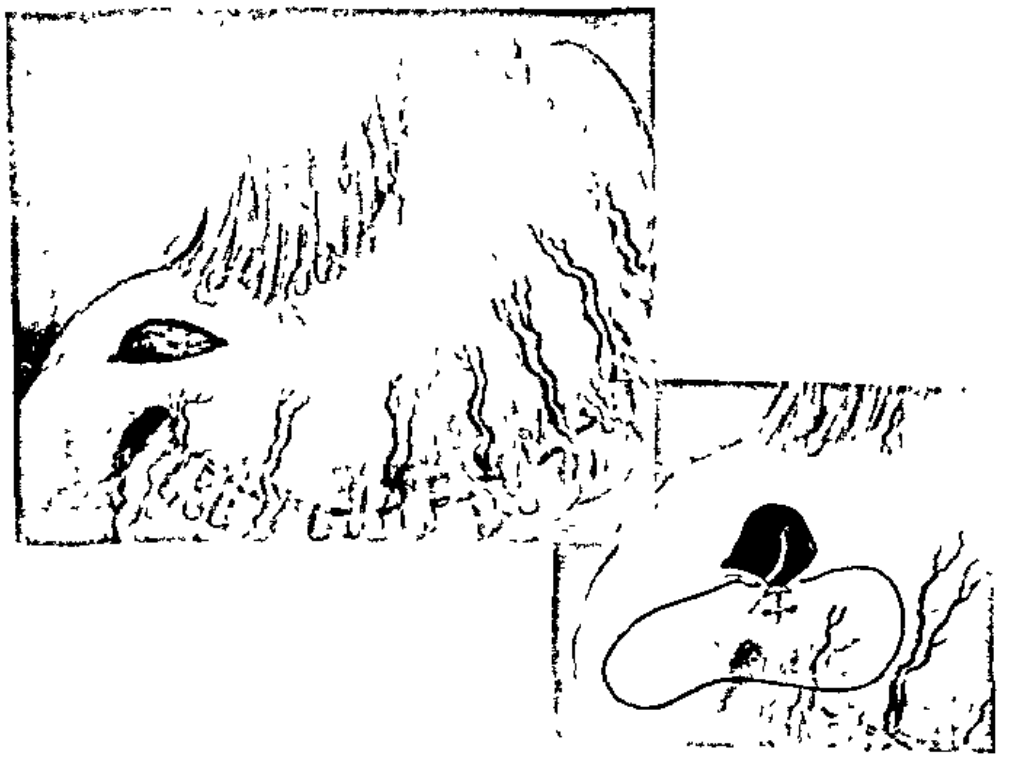

FIG. 320.—Technic of pyloroplasty. After completion of vagotomy either a pyloroplasty or a gastroenterostomy is performed in order to facilitate emptying of the denervated stomach.

of the surgeon. Whenever feasible, pyloroplasty would appear to be the operation of choice because of its simplicity, because it entails no disturbance of normal mechanical or physiologic processes, and also because, if ulceration should recur, gastric resection could be performed with ease and without the difficulty involved in taking down a gastroenterostomy. But there are many cases in which the duodenum is fixed and foreshortened, in which pyloroplasty is not easily accomplished and gastroenterostomy is preferable. In about 50 per cent of the cases, however, a simple longitudinal incision through the pyloric muscle and the narrowest portion of the duodenum can be sutured transversely with correction of any tendency to obstruction (Fig. 320). Before the pylorus

and again divided several centimeters lower. The excised segment 2 to 5 cm. in length is examined by the pathologist to prove its identity.

After completion of the anterior vagotomy the forefinger of the left hand is inserted through the delicate peritoneum of the gastrohepatic omentum above the gastric vessels, as in mobilization of the stomach for total gastrectomy The stomach is again pulled downward by the right hand, and the posterior vagus is located by palpation as a tense cord

FIG. 319 – Locating posterior vagus nerve Posterior vagus usually lies behind and to the right of esophagus, is often well away from esophagus Downward traction is exerted on stomach, and posterior vagus is located by palpation

lying posterior to the esophagus in the areolar tissue. Occasionally it appears to lie more to the right of the esophagus than directly posterior and may be surprisingly far away from it While an assistant pulls the stomach and esophagus downward anteriorly and to the left, the nerve which is identified by the index finger of the left hand is picked up by a nerve hook and is dissected out, as in the case of the anterior nerve. It is important to make certain that it passes upward through the esophageal hiatus since there are vessels posteriorly that could be confused with the vagus if its course through the hiatus is not checked. After denervation

in which the patient was a poor surgical risk, was the only instance in which technical difficulties have arisen during vagotomy and the only one in which a proposed vagotomy was not completed.

In several cases no large posterior vagus trunks could be located, but several small nerves were found and divided. Occasionally there are as many as five or six nerves instead of the usual main trunks. Only once was a blood vessel cut by mistake, and in this case the bleeding was easily controlled.

Insulin tolerance tests have not been made following operation because pyloroplasty or gastroenterostomy causes a regurgitation of bile into the stomach and invalidates the test.

SUMMARY

1. After two and one-half years of experience with transabdominal vagotomy coupled with pyloroplasty or gastroenterostomy for duodenal ulcer, we believe it to be (*a*) safer than gastric resection, (*b*) more effective than gastric resection in controlling the tendency to recurrent ulceration, and (*c*) attended by lesser morbidity and disability than is gastric resection.

2. The results obtained with vagotomy and gastroenterostomy or pyloroplasty justify this procedure as the treatment of choice when surgical intervention is indicated for duodenal ulcer.

3. Duodenal ulcer is primarily a medical problem, and operation should not be advised until medical management has been given a fair trial.

4. Most cases of gastric ulcer requiring operation should be treated by gastric resection rather than by vagotomy.

5. Vagotomy for gastric ulcer is not recommended unless (*a*) the ulcer is excised and examined microscopically, or (*b*) the ulcer is so high that it cannot be resected without performing a total gastrectomy or incurring undue risk.

6. Transabdominal vagotomy is the preferred treatment for gastrojejunal ulcer.

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SURGICAL TREATMENT OF REGIONAL ENTERITIS

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PROLONGED observation of an increasing number of cases of regional enteritis has shown that in most instances surgical treatment is necessary. Even though regional enteritis usually has a slow and benign course, the progressive pathologic changes in the wall of the bowel so alter intestinal function that serious illness results. Our ignorance of the cause of the disease, the lack of a specific remedy and the nature of the pathologic changes preclude the possibility of a highly successful program of medical management.

The chronic invalid state of regional enteritis is characterized by cramp-like abdominal pain, diarrhea, anemia, malnutrition and draining fistulas. The development of fistulas, either internal or external, may follow operations or may occur spontaneously and is a common cause of morbidity. The severity of the symptoms depends upon the stage and activity of the disease, the location and the extent of involvement of the intestine. The efficacy of surgical treatment has been proved by the frequent restoration of a chronically debilitated patient to a normal state of health after operation.

DIAGNOSIS

A survey of fifty-five cases treated at the Cleveland Clinic[1] revealed the symptoms and physical findings in these patients (Table 1) to be similar to those originally described by Crohn, Ginzburg and Oppenheimer.[2] Cramplike abdominal pain, loss in weight, diarrhea and fistula formation are the most common symptoms, and frequent physical findings are tenderness in the right lower quadrant of the abdomen with or without a palpable mass, fever and the presence of fistulas. A mild to moderately severe anemia, usually of the hypochromic microcytic type, and leukocytosis often are present and are proportional to the degree of malnutrition and sepsis. Examination of the stool sometimes shows the presence of pus, fatty acid crystals and occult blood, but these findings are not of specific diagnostic value.

Roentgenologic studies of the colon should be made in all patients suspected of having regional enteritis. The regurgitation of barium through the ileocecal valve during examination with the barium enema has been a helpful method of demonstrating the "string sign" (Kantor[3]) when the

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lesion is located in the terminal ileum. Examination of the colon also demonstrates the presence of colitis with or without "skip" areas and may arouse suspicion as to the presence of ileitis if the terminal ileum cannot be filled. Roentgenologic studies of the small intestines should also be made after the oral administration of barium to demonstrate changes above the terminal ileum and the presence of "skip" areas of involvement proximal to a previously shown lesion. A plain film of the abdomen may be of value if the disease is complicated by obstruction but does not establish a differential diagnosis of the cause. A roentgenogram of the chest should always be made to exclude the presence of tuberculosis.

Proctoscopic examination should be made in all cases to exclude the possibility of coexisting colitis. In some instances edema or small punctate ulcerations of the rectal mucosa, quite different from the usual picture of ulcerative colitis, may be noted.

TABLE 1

SYMPTOMS IN FIFTY-FIVE CASES

	Crampike Abdominal Pain	Significant Weight Loss	Diarrhea	Draining Abdominal Sinus
Number of cases	40	33	27	14

The diagnosis of regional enteritis is usually not difficult if this condition is considered when dealing with patients who have symptoms suggesting acute appendicitis, ulcerative colitis, or intestinal obstruction. The disease should be suspected in all patients who have draining abdominal fistulas after operation, enterovesical fistulas, enterovaginal fistulas and anal fistulas. Regional enteritis also may cause an unexplained fever without intestinal symptoms.

A definite diagnosis depends on positive roentgenologic findings, but

lumen by the stenosing and fibrosing process. Ulceration of the mucosa is most notable along the margin of the mesenteric border. The mesentery is often greatly thickened and shortened and the lymph nodes enlarged. Dense adhesions may be present between various loops of bowel and parietal peritoneum, and external or internal fistulas may be seen.

Regional enteritis must be differentiated from other acute and chronic inflammatory lesions and from neoplasms of the intestine. In the acute

form it may be confused with appendicitis. The presence of mild symptoms of cramplike abdominal pain, loss of weight and diarrhea for days or weeks before the acute episode should suggest the possibility of regional enteritis and lead to careful roentgenologic examination of the small bowel.

The terminal ileum may be involved as the result of the extension of ulcerative colitis. In these patients, however, the disease process is usually an extensive one with severe bloody diarrhea and characteristic roentgenologic and proctoscopic findings of ulcerative colitis which establish the diagnosis. Tuberculosis may involve the terminal ileum and the right colon and be indistinguishable from regional enteritis by roentgenogram. In the absence of pulmonary tuberculosis it is unlikely that a lesion in the terminal ileum is due to tuberculosis, whereas the presence of active pulmonary tuberculosis suggests concomitant tuberculosis of the bowel.

The positive identification of Endamoeba histolytica in the stool and a favorable response to antiamebic therapy aid in differentiating regional enteritis from amebic granuloma.

Neoplasms of the small intestine may produce clinical and roentgenologic pictures similar to those of regional enteritis. If it is not possible to make a definite differentiation by roentgenologic examination, an exploratory laparotomy is indicated.

MEDICAL TREATMENT OF REGIONAL ENTERITIS

The efficacy of any form of treatment for regional enteritis cannot be evaluated properly unless the patient has been examined repeatedly, both clinically and by x-ray, over long periods of time, as recurrences are common even after all diseased bowel has been surgically removed. Garlock and Crohn[4] reported a case in which there was a recurrence twelve years after the initial operation. In one of our patients the disease recurred at the end of nine and one-half years.

The medical treatment of regional enteritis should be limited to (1) early acute cases, (2) mild chronic cases without fever, wasting, or obstruction, and (3) diffuse involvement of a large part of the bowel.

As there is no specific remedy for regional enteritis, medical management includes bed rest, a high calorie, high protein, low residue diet, vitamins, iron, blood transfusion and the use of various sulfonamide and antibiotic preparations. Large doses of penicillin may be of some value in fulminating acute cases but are of no value in the chronic stages.

All acute cases of regional enteritis do not progress to a chronic cicatrizing stage. While on military duty we have observed several cases of acute regional enteritis which subsided without any treatment other than exploration. There was no recurrence of symptoms, at least for the period

of a few months in which the patients were followed, and the disease could not be demonstrated by roentgenologic examination. One patient operated on at the Cleveland Clinic had an acute jejunitis and has been well for seven and one-half years after an exploratory laparotomy. In the acute cases conservative management appears to be safer than radical operations. If the disease becomes chronic and symptoms persist, definite surgical treatment is indicated.

Patients whose symptoms are mild and who have neither fistulas, fever, nor symptoms of obstruction should be given a trial on medical management in the hope that a spontaneous remission will occur. Two patients in this category have been observed for two years and two and one-half years, respectively, and are completely free of symptoms. However, operation should be performed upon all patients who continue to lose weight and strength while receiving conservative treatment.

INDICATIONS FOR OPERATION

The majority of cases of regional enteritis may be classified in two groups. Operation is indicated in both groups.

1. Patients with chronic regional enteritis without obstruction or fistulas who fail to enter a remission after medical treatment. Since irreparable damage has already occurred in these cases, it is probably not worth while to attempt conservative treatment if symptoms are severe or of even moderate severity.

2. Patients with obstruction or fistulas do poorly on medical treatment and should be operated upon unless the extent of the involvement of the intestine renders the situation hopeless.

SURGICAL TREATMENT OF ACUTE REGIONAL ENTERITIS

In acute regional enteritis the symptoms may be of such short duration that the diagnosis is not suspected prior to the operation. At the time of operation, a segment, several segments, or even a major portion of the small bowel may be red and thickened and the mesenteric lymph nodes enlarged, the area involved is often sharply demarcated from the normal bowel. Sometimes, despite the fact that the onset of symptoms has been acute, the changes in the bowel have the typical appearance of the chronic phases of the disease.

Since in the acute cases the diagnosis is not usually established before operation, the patients are not prepared for anastomosis or resections of the bowel. Under these circumstances it is often wise to do nothing more than explore the abdomen and defer any decision as to the necessity of more radical operations until the condition of the patient can be evaluated. In at least one case a second operation was performed because of a

lesion found at the first operation, but thorough exploration failed to reveal any trace of the initial lesion. We therefore believe that in some cases acute regional enteritis is reversible and should be given a trial on conservative treatment before more radical measures are undertaken. One hundred thousand units of penicillin given every two hours has sometimes appeared to speed the subsidence of acute symptoms.

The appendix can be removed safely in some but not all cases of regional enteritis. When the cecum is involved, removal of the appendix may result in a fecal fistula. Since minimal or early involvement of the cecum is not always apparent on gross examination the appendix should not be removed if the underlying disease is recognized.

SURGICAL TREATMENT OF CHRONIC REGIONAL ENTERITIS

If symptoms are mild, if there are no fistulas, if there is no evidence of intestinal obstruction, and if the patient is not anemic, febrile, or losing weight, there is no need to advise operation for uncomplicated regional enteritis. The disease does not appear to spread any more rapidly or any further if the involved area is resected than if it is not. The situation appears comparable to a localized area of neurodermatitis. Whether or not this area will increase is dependent on some systemic factor rather than on contagion from a local focus. Removal of a segment of ileum probably gives no more protection against spread or recurrence of enteritis than does excision of the plaque of dermatitis protect against extension of this disease.

Since resection of the bowel does not appear to have any effect upon the underlying cause of the disease, operation cannot be regarded as anything more than a form of symptomatic treatment. Operation is indicated only when the symptoms are intractable and when the complications are serious or disabling.

If the symptoms are severe and intractable, especially if complications such as intestinal obstruction, anemia, fever, or nutritional disturbances are present, an operation gives good prospect of relief. Some surgeons prefer to resect the affected bowel, others to divide the bowel and make an anastomosis, usually an ileotransverse colostomy, in such a way as to exclude and sidetrack the terminal ileum and right colon. In our experience, unless fistulas are present, the exclusion operation with division of the bowel has been safer than resection and just as effective in relieving symptoms and restoring the patient to a state of health and well-being. When fistulas are present resection is a more prompt and certain method of assuring their closure. In the absence of external fistulas, however, short-circuiting operations, provided that the involved bowel is excluded, bring relief of symptoms and cause large inflammatory masses to disap-

pear. If the bowel is not divided so as to exclude completely the involved area, symptoms usually persist and a second operation is necessary.

CASE I —A man 32 years of age complained of vomiting, loss of 65 pounds in weight and epigastric pain of four years' duration. Physical examination showed no abnormalities except for evidence of loss of weight Proctoscopic examination disclosed an area of localized inflammation in the sigmoid 6½ inches from the anus

Roentgenologic examination after a barium meal demonstrated an area of constriction of the proximal jejunum with partial obstruction A diagnosis of regional enteritis was made and operation advised

At operation it was found that the first 6 inches of the jejunum was involved in a chronic inflammatory process The remainder of the small bowel was normal except for an area of regional enteritis involving the distal 6 inches of the ileum A Meckel's diverticulum also was present, arising in an apparently normal section of the ileum.

A gastroenterostomy was performed, the Meckel's diverticulum was excised, and the ileum was divided 10 inches from the ileocecal valve The ends were turned in and a side-to-side anastomosis was made between the proximal ileum and the transverse colon

Convalescence was uneventful The patient left the hospital on the eighth day after operation Two months later he reported that he had gained 20 pounds and had had no gastrointestinal symptoms Proctoscopic examination for 10½ inches was negative, indicating that the inflammatory reaction had probably been secondary to the ileitis and had subsided after the ileum was excluded

DIFFUSE SEGMENTAL ENTERITIS

Regional enteritis sometimes involves most of the small bowel and part of the large bowel, or sometimes all of the large bowel and part of the small bowel, occasionally there are "skip" areas involving sections of small or large bowel or both. In the more extensive cases operation should not be attempted other than possibly an ileostomy in those patients having an associated severe ulcerative colitis with intolerable symptoms When the involvement is chiefly in the small bowel, resections or exclusion of up to 50 or 60 per cent of the bowel can be performed without seriously impairing the nutrition of the patient In vascular lesions of the small bowel even more radical resections have been reported,[4] but the tendency for inflammatory disease to recur and to interfere with absorption in the remaining portion of the bowel renders such radical resections for regional enteritis of questionable value.

When the bowel is involved in "skip" areas with normal bowel intervening, the involved areas can be by-passed by multiple anastomosis or can be resected, but unless obstruction is present or unless there are

fistulas, extensive "skip" areas are best left alone. The risk of multiple anastomoses between loops of potentially diseased bowel may be considerable. When obstruction is present, however, the risk must be assumed, and if all goes well the results may be excellent.

CASE II.—A woman 22 years of age complained of pain in the right lower quadrant of the abdomen of ten days' duration. Her appetite had been poor for five years and she had lost 23 pounds the past three years She had always been constipated

Physical examination was normal except for undernutrition and a mass in the region of the right adnexa and cul-de-sac. The possibility of regional enteritis was suspected because of the nature of the mass. Roentgenograms of the small bowel after administration of a barium enema showed that the distal 4 inches of the terminal ileum filled normally, but above this point the ileum was narrow and the mucosal pattern was irregular

After administration of barium by mouth a short fistulous tract was visualized in the pelvis, and a diagnosis of regional enteritis was made.

At operation the cecum and several feet of the terminal ileum were found to be involved in a chronic inflammatory process and were fixed in the pelvis. The bowel was divided above the involved area, the ends were turned in, and a side-to-side ileotransverse colostomy was made.

Convalescence was uneventful, and the patient left the hospital on the seventh postoperative day Six weeks later she had gained 7 pounds and was feeling entirely well. The pelvic mass was no longer palpable by either pelvic or abdominal examination

TECHNIC

The technic of anastomosis is a matter of personal preference, but in our experience a side-to-side anastomosis has proved safer than an end-to-side or end-to-end. Catgut is used throughout in two layers of continuous sutures. The operation is open, rubber shod clamps being used to prevent soiling The commonest site of anastomosis is between the proximal loop of the transected ileum and the transverse colon.

If the bowel is resected no attempt is made to remove all of the enlarged lymph nodes which are found at the root of the mesentery. These will subside spontaneously after the bowel has been removed. The bowel should be divided at least 6 inches away from the last grossly involved segment to assure healthy tissue for anastomosis.

RESULTS

In a group of fifty-five patients forty-seven survived the immediate postoperative period and forty have been followed for from one to fifteen years. Of this group twenty-one patients have been subjected to side-

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When the bowel is involved in "skip" areas with normal bowel intervening, the involved areas can be by-passed by multiple anastomosis or can be resected, but unless obstruction is present or unless there are

2. Medical treatment for regional enteritis should be reserved for the acute and mild chronic cases and for those with diffuse involvement.

3. Surgical treatment should be employed in patients having chronic enteritis with moderate to severe symptoms, in diffuse enteritis and in regional enteritis with complications such as fistula or obstruction.

4. A side-to-side anastomosis without exclusion of the diseased segment of bowel rarely results in a longstanding remission of symptoms.

5. Anastomosis with division of the bowel and exclusion of the involved segment usually results in remission of symptoms. The early results are as good as those obtained by resection.

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MALIGNANT TUMORS OF THE SMALL INTESTINE

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Malignant tumors of the small intestine are found in fewer than two cases a year at the Cleveland Clinic. This rarity of occurrence may have led to insufficient study of these tumors and to delay in their recognition. It has seemed advisable, therefore, to assemble the data regarding these cases and to evaluate modern methods of diagnosis and treatment.

From 1922 to 1946 there occurred among our patients forty malignant tumors in the small intestine, thirty-six of these being found at operation and four at autopsy. Of the three varieties of tumor, carcinoma occurred in twenty-one cases, sarcoma in thirteen cases, carcinoid in five cases, and both a sarcoma and a carcinoid in the terminal ileum in one case.

The carcinomas encountered in the small bowel are, according to Ewing,[1] mostly adenocarcinomas and may arise from polyps. Infiltration of the wall may cause stenosis of the lumen and result in intestinal obstruction. Intussusception is a rare complication and perforation still more infrequent. In the majority of cases metastasis has occurred before the patient is subjected to operation.

The term spindle-cell sarcoma includes leiomyosarcoma, fibrosarcoma and neurogenic sarcoma. Lack of differentiation may make difficult the accurate identification of the specific cell type. Sarcomas of the small intestine tend to grow outward from the serosa, therefore stenosis of the lumen is a rare and late complication. Symptoms of obstruction may occur from pressure of the mass or kinking of the bowel.

Carcinoid tumors arise from the Kultschitzky, or argentaffine, cells deep in the glands of the mucosa. They are found in the small intestine, usually occurring as small, firm, yellowish, circumscribed nodules in the submucosa. The larger tumors invade locally and may metastasize to regional lymph nodes and occasionally to the liver. Microscopically these neoplasms are composed of small masses of cuboidal cells which, when impregnated with silver, reveal argentaffine granules.

INCIDENCE

Malignant tumors of the small intestine form only 3 per cent of the malignant tumors found throughout the intestinal tract.[1] In 269 cases

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collected from autopsy reports Shallow[2] found the incidence of primary malignant tumors of the small intestine to be 0 to 1 per cent, compared with 3.6 per cent of similar tumors in the large intestine. Malignant disease occurred with equal frequency in all three divisions of the small intestine, but sarcoma was more frequent in the ileum and carcinoma in the duodenum and jejunum. In the duodenum carcinoma was six times as frequent as sarcoma, in the jejunum three times as frequent, and in the ileum only one half as frequent.

Incidence of the three types of malignant tumors in the Cleveland Clinic series is shown in Table 1. Classification in this series was as follows:

TABLE 1

INCIDENCE OF THREE TYPES ACCORDING TO SITE

Site	Carcinoma	Sarcoma	Carcinoid
Duodenum	4	1	0
Jejunum	4	5	1
Ileum	13	6	3
Multiple	0	2	2
Total	21	14	6

Carcinoma

Adenocarcinoma	19
Carcinoma simplex	1
Scirrhous	1

Sarcoma

Spindle-cell sarcoma	7
Lymphosarcoma	4
Reticulum cell sarcoma	2
Melanosarcoma	1

Carcinoid

Argentaffinoma	5

Age.—C. W. Mayo,[3] reporting in 1940 on a series of 108 malignant tumors of the small intestine, found that the average age of patients was 52.6 years. Occurrence among men was two and one half times that among women. Lymphosarcoma occurred more frequently in the third and fourth decades, and carcinoma was more common in the fourth and fifth decades. This corresponds with the age distribution of patients in

our series in which the average age of patients with carcinoma was 53.1 years, sarcoma 43.7 years, and carcinoid 54 years.

Arranged according to decades the disease occurred as shown in Table 2.

SYMPTOMS

Because the contents of the small intestine are liquid and obstruction is a late manifestation of the disease, and because bleeding of sufficient severity to give symptoms rarely is observed, the symptoms of malignancies of the small intestine appear late, when the disease is far advanced.

Symptoms of advanced malignancy of the small intestine are general weakness, loss of weight, fatigue, anemia and cramp-like pain in the midabdomen. These symptoms may be insidious, and several months

TABLE 2

INCIDENCE BY DECADE OF LIFE

Decade	Carcinoma	Sarcoma	Carcinoid
Third	2	3	1
Fourth	2	4	2
Fifth	14	4	1
Sixth	3	3	0
Seventh	0	0	2
Total*	21	14	6

* One patient had sarcoma and carcinoid

may elapse before a physician is consulted. Pain develops late and may be intermittent. Constipation is common but may alternate with diarrhea. Nausea and vomiting or symptoms of obstruction or perforation may occur. Occasionally a patient detects a mass in the abdomen.

Symptoms in this series occurred as follows:

	Per Cent
Weight loss (5 to 60 pounds)	88
General weakness	84
Fatigue	84
Anorexia	78
Pain (cramps in midabdomen)	77
Nausea and vomiting	63
Constipation	59
Palpable mass	22
Diarrhea	19

In the patients with sarcoma 77 per cent had a red cell count below 4,100,000, while with carcinoma only 33 per cent of patients had subnormal counts, and with carcinoid no counts were below normal. The average hemoglobin level was 71 per cent, with a high of 111 per cent and a low of 25 per cent. Only two patients had noted rectal bleeding.

When the lesion was high in the gastrointestinal tract the symptoms impelled the patient to seek relief earlier. The average time before the patient submitted to operation was two months for duodenal carcinoma, eight months for jejunal carcinoma and twelve months for carcinoma of the ileum.

A palpable tumor mass was present in nine cases, four in the ileum, two in the jejunum, one in the duodenum, and two in multiple areas.

DIAGNOSIS

Chont[4] has suggested that a "radiation biopsy" of 200 r of deep roentgen therapy may aid in establishing the diagnosis. If the tumor is a lymphosarcoma there may be a recognizable diminution in size within seventy-two hours. This procedure, however, is of limited application as compared to roentgenography. Since 1942, 46 per cent of the cases have been diagnosed by the roentgenologist as obstructing lesions, probably neoplasms. Erroneous clinical diagnoses which have been made in these cases of malignant tumors of the small bowel have included intestinal obstruction, duodenal ulcer, diverticulitis, pancreatitis, salpingitis, and carcinoma of the stomach, pancreas and rectosigmoid.

The technic of roentgenography is more reliable if only a small amount, not over 2 ounces, of a thin suspension of barium is given by mouth. In this way large amounts of barium in different intestinal loops do not overlap each other. The loops can be manipulated under the fluoroscope, and films can be taken for better visualization of detail. The time for taking interval films varies from minutes to hours and depends upon the observation made at fluoroscopy. When the lesions lie low a barium enema will afford better visualization of the terminal ileum.

TREATMENT

If it has been possible to attack the disease comparatively early in its course the treatment of choice is resection of the involved portion of the bowel with a wedge of mesentery, followed in most cases by a side-to-side anastomosis. If the ileocecal valve is involved, it may be necessary to resect the terminal ileum and part of the ascending colon and re-establish continuity of the intestinal tract by ileotransverse colostomy. If the tumor is fixed or if extensive metastases are present it may be preferable

to by-pass the tumor by such palliative procedures as enteroenterostomy or gastroenterostomy

Postoperative x-ray therapy is indicated in the treatment of sarcoma but has little effect on carcinoma or carcinoid.

Special symptoms require appropriate treatment. Dehydration, edema, anemia, avitaminosis, or evidence of chemical imbalance should be corrected before operation. A Miller-Abbott tube should be passed forty-eight hours before operation and allowed to remain in place after

TABLE 3

OPERATIONS EMPLOYED

	Carcinoma	Sarcoma	Carcinoid	Total
Resection and anastomosis	11	9	2	21
Resection and ileocolostomy	2	2	0	4
Enteroenterostomy	3	1	1	5
Gastroenterostomy	4	0	0	4
Biopsy	1	1	0	2

TABLE 4

RESULTS IN VARIOUS SERIES

Surgeon	Cases	Operative Mortality (per cent)	Patients alive over 5 Years
Fraser	15	60	1
Cameron	200	30	16
Mayo and Nettrour	31	20	2
Cleveland Clinic series	35	17	3

operation. This procedure usually will prevent the development of ileus, and when this danger has passed the tube may be removed.

The procedures carried out on the thirty-six patients in this series are shown in Table 3.

PROGNOSIS

Since malignant tumors of the small intestine give few if any symptoms in their early stages and since they usually are advanced and have metastasized before the diagnosis is made, the results of treatment are poor. Only in the carcinoid tumors is the prognosis favorable.

Eight of the nine patients still living are in good health. The other

patient now has metastasis to the peritoneum and will not long survive.

Six of our patients died following operation. The duration of survival of these still alive is shown in Table 6 Analysis reveals that most deaths occurred in the hospital following operation or within one year of discharge (Table 7).

TABLE 5

SURVIVAL IN CLEVELAND CLINIC SERIES ACCORDING TO TYPE OF TUMOR

Type of Tumor	Alive	Died (All Causes)	Follow-up Data Not Available
Carcinoma	2	13	6
Sarcoma	6	2	4
Carcinoid	1	1	1
Total	9	16	11

TABLE 6

DURATION OF SURVIVAL OF THOSE STILL ALIVE

Type of Tumor	1 Year or Less	3 Yrs	5 Yrs	17 Yrs
Carcinoma	0	1	1	0
Sarcoma	4*	1	1	0
Carcinoid	0	0	0	1

* One has recurred

TABLE 7

TIME OF DEATH IN RELATION TO OPERATION

Type of Tumor	Following Operation	6 Mos to 1 Yr	1-2 Yrs	5 Yrs
Carcinoma	5	5	2	1
Sarcoma	1	0	1	0
Carcinoid	0	0	1	0

Recurrence of the tumor was responsible for the death of eight patients who survived operation but died later. The patient who had had an enteroenterostomy for a large carcinoid tumor died two years after operation from extension of the growth Included in the operative mortality of 17 per cent are one death on the first postoperative day, three on the second, one on the eighteenth, and one on the twenty-fifth.

CASE REPORTS

Three cases are reported, the first of which is typical of carcinoma, the second of sarcoma, and the third an unusual coexistence of sarcoma and carcinoid in the terminal ileum.

CASE I.—A white man, 62 years of age, complained of severe cramplike pain in the abdomen, loss of appetite, loss in weight of 25 pounds, frequent vomiting, alternating constipation and diarrhea, and occasional mild bleeding from the rectum for five months.

Physical examination revealed a moderately emaciated man with pallor of the skin and mucous membranes. The abdomen was somewhat distended and tympanitic with tenderness to pressure to the right of the umbilicus. Rectal examination revealed no masses, tenderness, or hemorrhoids.

A Miller-Abbott tube was passed into the intestine. Dr. T. E. Jones explored the abdomen through a low midline incision and found an indurated mass involving the ileum 18 inches from the ileocecal valve The mass and a wedge-shaped piece of mesentery were resected, and a side-to-side anastomosis of the ileum was performed.

Pathologic examination revealed a small constricting lesion of the ileum with dilatation of the proximal loop and a small loop of kinked bowel incorporated in the mass. Microscopic examination showed the entire mucosa to be replaced by a new growth composed of sheets of highly atypical polygonal cells. Two lymph nodes were partially replaced by carcinoma simplex.

Recovery was uneventful. In July 1946 the patient was in excellent health.

CASE II.—A white woman, 58 years of age, complained of loss in weight of 5 pounds in two years. In the six months before entering the Clinic there had been dull, aching, midabdominal pain and intermittent epigastric fullness and distress. For two months she had had a poor appetite and for three weeks had vomited one hour after eating.

Physical examination revealed a tender movable mass $2\frac{1}{2}$ inches in thickness just to the right of the umbilicus, and generalized tenderness over the epigastrium and right upper quadrant of the abdomen

Roentgenologic examination revealed a markedly narrowed segment of upper jejunum in the right side of the abdomen, measuring about 12 cm. in length, with some dilatation of the bowel proximal to the lesion. A tentative diagnosis of lymphosarcoma of the small intestine was made.

Laboratory examination revealed a count of 3,700,000 red blood cells and hemoglobin of 43 per cent.

The patient was admitted to the hospital, a Miller-Abbott tube was passed, and three blood transfusions were given. The abdomen was explored by one of us (R. S. D.) through a right midrectus incision and a smooth glistening tumor mass involving about 16 cm of jejunum was found (Fig. 321). The involved bowel and corresponding wedge of mesentery were resected, and a side-to-side anastomosis was performed. The postoperative course was uneventful.

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DURATION OF SURVIVAL OF THOSE STILL ALIVE

Type of Tumor	1 Year or Less	3 Yrs	5 Yrs	17 Yrs
Carcinoma	0	1	1	0
Sarcoma	4*	1	1	0
Carcinoid	0	0	0	1

* One has recurred

TABLE 7

TIME OF DEATH IN RELATION TO OPERATION

Type of Tumor	Following Operation	6 Mos to 1 Yr	1-2 Yrs	5 Yrs
Carcinoma	5	5	2	1
Sarcoma	1	0	1	0
Carcinoid	0	0	1	0

Recurrence of the tumor was responsible for the death of eight patients who survived operation but died later. The patient who had had an enteroenterostomy for a large carcinoid tumor died two years after operation from extension of the growth. Included in the operative mortality of 17 per cent are one death on the first postoperative day, three on the second, one on the eighteenth, and one on the twenty-fifth

the cecum. A small tumor was also palpable at the ileocecal valve. Resection of the terminal ileum and ascending colon with ileotransversostomy was performed.

Pathologic examination revealed a leiomyosarcoma of the ileum 19 cm. from the ileocecal valve, measuring 10 5 cm in diameter, and an argentaffinoma of the ileum at the ileocecal valve measuring 3 cm. in diameter. No metastases were found in the lymph nodes.

The patient was discharged from the hospital on the eighteenth postoperative day. There was no evidence of recurrence ten months later.

CONCLUSIONS

1. Malignant tumors of the small intestine are rare
2. Symptoms do not occur until late in the course of the disease.
3. The diagnosis is rarely established before extension or metastasis has rendered the disease incurable.
4. With careful roentgenographic technic the correct diagnosis can be established in about half the cases.
5. Radiation may be of value in the treatment of lymphosarcoma.
6. The intestine should be intubated preoperatively and the tube left in place after operation until the danger of ileus is past.
7. The prognosis of malignant tumors of the small intestine is poor.
8. If patients with malignancy of the small intestine are to be cured, the diagnosis must be established earlier than it has been in the past.

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SURGICAL MANAGEMENT OF CARCINOMA OF THE COLON AND RECTUM

T. E. Jones, M.D., F.A.C.S.

Great improvements have occurred in the surgical management of carcinoma of the colon and rectum in the past twenty-five years. Anatomy, of course, has not changed, surgeons have not suddenly become expert, cancer has not changed its fatal tendencies; but improvement in surgical technic and the application of physiologic principles have increased the scope of operability, lowered the mortality, decreased the morbidity and increased the curability. Allied branches of medicine, such as roentgenology, have contributed materially to the earlier recognition of malignancy, and the renewed interest of pathologists has led to a better understanding of its spread; this knowledge has been very helpful to the surgeon in his approach. Early diagnosis, good preoperative preparation, improved anesthesia and chemotherapy have all contributed to rendering the problem a much more hopeful one than formerly.

I think that one of the greatest contributions to colonic surgery is the atraumatic weldon needle suture, yet one rarely gives it a thought unless he remembers the old days when the ordinary needle was used in anastomosis. Intestinal intubation by the Miller-Abbott and other tubes has almost eliminated the necessity of postoperative laparotomy for intestinal obstruction which used to be such a tremendous factor in mortality. The young student, in considering his results with those of surgeons in those days, will be a little charitable when he adds up one by one the many things that have so altered the picture.

NEED FOR EARLY DIAGNOSIS

From descriptions of operations performed, radical procedures appear to be the vogue. From an anatomic standpoint the surgeon has almost reached the limit in the eradication of malignant disease of the colon and rectum. Further benefits must come from earlier diagnosis, which obviously is lagging far behind improvement in surgical technic. Therefore, even though this paper deals with the surgical aspect, I would be remiss if I did not emphasize again the importance of early diagnosis. In my opinion it would be better for the next five years for surgeons to stop talking about surgical technic and to stop compiling mortality and recovery statistics in order to spend their time talking about early diag-

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nosis. The surgeon alone realizes the tragedy of the late cases when he learns of a history that the patient had symptoms six months to a year previously. Many of these patients, I regret to say, had consulted physicians. The American Cancer Society and its program for cancer control was not originated by public health authorities, governmental agencies, or any professional group but has evolved from popular demand. Let us as a group not be delinquent. With an accurate history and a thorough examination we can eradicate many of our trials and tribulations. For instance, (1) everyone knows that 75 per cent of all cases of cancer of the colon are located where they can be felt with the finger or easily seen with the proctoscope, (2) the roentgenologist knows that the rectum is a blind spot for early diagnosis, and (3) we all know that it is easier to order a roentgenogram of the colon than to think.

Suppose that the roentgenologist had to have an affidavit to make an x-ray examination or the moral courage to refuse before a digital and proctoscopic examination had been done. Who would benefit? (1) The patient, because the condition was discovered early, easily, and without much expense, (2) the doctor, in taking just pride in his accomplishment, (3) the roentgenologist, because he did not make a mistake or precipitate an impending obstruction by filling the colon with barium.

CHOICE OF METHOD OF OPERATION

From the standpoint of surgical technic there are admittedly many different methods of accomplishing a certain operation in a certain segment of the colon. The one fundamental prerequisite, however, is as extensive and as radical an operation as possible. Whether this is done by the closed or open method, by the one-stage or two-stage method, or by any other technic makes little difference provided the surgeon can show that his results, from the standpoint of mortality and morbidity, are equal to those of other technics. Perfecting one technic is more desirable than trying every new procedure that is introduced.

While one may prefer a certain standard procedure in certain segments of the colon, the findings at operation may necessitate a variation in technic. Obstruction, subacute perforation, or fixation must alter the course of even the staunchest advocate of the one-stage procedure. Graded procedures are necessary for utmost safety in this limited group of cases. In the final analysis the main controversy in surgery of the colon revolves around (1) the one-stage or two-stage procedure and (2) the open or closed aseptic method of anastomosis. Improvements along one line or another may cause a change of method. For instance, sulfonamide therapy may change a two-stage operator into a one-stage advocate, or the use of the Rankin clamp may persuade an advocate of the open

method to use the closed method. However, I think less depends on the method used than on the manner of its execution.

A cursory review of mortality figures in recent years shows a range of 10 to 25 per cent for the same operation. This disparity is probably due to the manner of execution. I have always believed that peritonitis results not so much from soiling at the time of operation as from leakage at the suture line or secondary to a bad wound infection. Since this can happen in the two-stage anastomotic procedure as well as in the one-stage method, I prefer the latter

In all statistics a higher mortality is quoted for palliative anastomosis and resection than for completed cases This probably illustrates the importance of vitamin and plasma protein deficiency in the healing of infection and wound. The patient with advanced malignancy is probably lacking in both of these essentials and therefore cannot tolerate a minor procedure. However, cancer is a fatal disease, and operative mortality cannot be viewed in the same light as in nonfatal cases. The surgeon must be courageous. His responsibility is to palliate as well as to try to cure. The decision in any individual case rests upon his experience, his philosophy regarding malignant disease, the patient, and the lesion.

Lesions in the right colon, whether in the cecum, ascending colon, or hepatic flexure, are best treated by right colectomy, with side-to-side open anastomosis. I believe that the postoperative morbidity is less in these cases than in the group of end-to-side anastomoses over the Rankin clamp, which I formerly did. My preference in this group of cases is the one-stage right colectomy.

Formerly a small catheter was inserted by Witzel's method into the ileum about 6 or 8 inches from the anastomosis to prevent tension on the suture line and to relieve pressure within the bowel. This technic has been changed, and the Miller-Abbott tube has been substituted with most gratifying results. It is put in place the day before operation.

The great advantage of the one-stage procedure is economy in hospitalization and rehabilitation time, although economy cannot be an argument against safety. In either case these patients must have a few days of preoperative care, in which transfusion is of first importance because secondary anemia is common in many. One of the greatest difficulties in resection of the right colon, particularly in the very obese patient, is peritonealization of the right gutter. Improperly completed, it will lead to adhesions and obstruction, a definite factor in mortality. For several years we have obviated this complication by the use of the modified Mikulicz pack. This pack prevents the small intestine from becoming adherent, and the postoperative convalescence is therefore much smoother.

The abdominal surgeon is frequently confronted with the problem of dealing with large surfaces which cannot be reperitonealized or covered with omentum after extensive dissections of adherent masses. In regional enteritis, for example, he may be forced to resect a fixed mass involving several feet of small intestine and perhaps a portion of the ascending colon, rendering the entire lower right region of the abdomen a raw oozing surface. After mobilization of a large neoplasm of the sigmoid, the major portion of the pelvic basin may be denuded of peritoneum.

We have been impressed in such cases with the value of mechanical exclusion of the small intestines from contact with such areas. If loops of small bowel are allowed to prolapse into a freshly denuded intra-abdominal basin, some degree of obstruction frequently occurs because of adherence and kinking Furthermore, if such an area is infected or *contaminated, at least a localized peritonitis will result The abdomen can* withstand peritoneal infection to a great degree, but the combination of *infection and obstruction may frequently be fatal* A mechanical barrier which will cover the unperitonealized surface and fill the space from which a mass has been removed will prevent such an occurrence

USE OF MIKULICZ PACK

Mikulicz,[1] in 1886, suggested the use of a gauze pack for walling off large unperitonealized areas after extensive pelvic operations Little attention was given the "Mikulicz pack," as it was subsequently named, until Faure[2,3,4] reintroduced it into France in 1921 Since then, many reports have appeared in the continental literature describing modifications in the technic and extensions of its application. Only a few articles have appeared in the English literature, and we believe the value of this contribution of Mikulicz may well be restated

The original Mikulicz pack consisted of a mesh sac packed with strips of gauze which was placed into the denuded pelvic basin. The gauze strips were removed gradually, and finally the surrounding mesh sac was removed, leaving a granulating cavity. Faure employed the pack in its original form at the conclusion of the radical Wertheim operation. The mesh sac of the original pack was replaced by gutta-percha, which had the advantage of easy removal The indications for the gutta-percha pack were extensive, not only did it exclude the small intestines from unperitonealized areas, but it also prevented prolapse of the intestines into abscess cavities. Gibson[5] in 1921 suggested the use of the modified pack in acute appendicitis. Farr[6] reported 162 cases and Weeden[7] 455 cases using the Gibson technic Price[8] described the "coffer dam," which may be considered a modification of the Mikulicz pack. Kennedy,[9] a pupil and staunch supporter of Price, practices the principle widely. Coffey[10] in

1937 reported a modification using gauze wicks surrounded with rubber dam, giving a comprehensive review of its application as a mechanical barrier and as a dam. He termed this pack an "abdominal quarantine," which is an apt phrase for the principle.

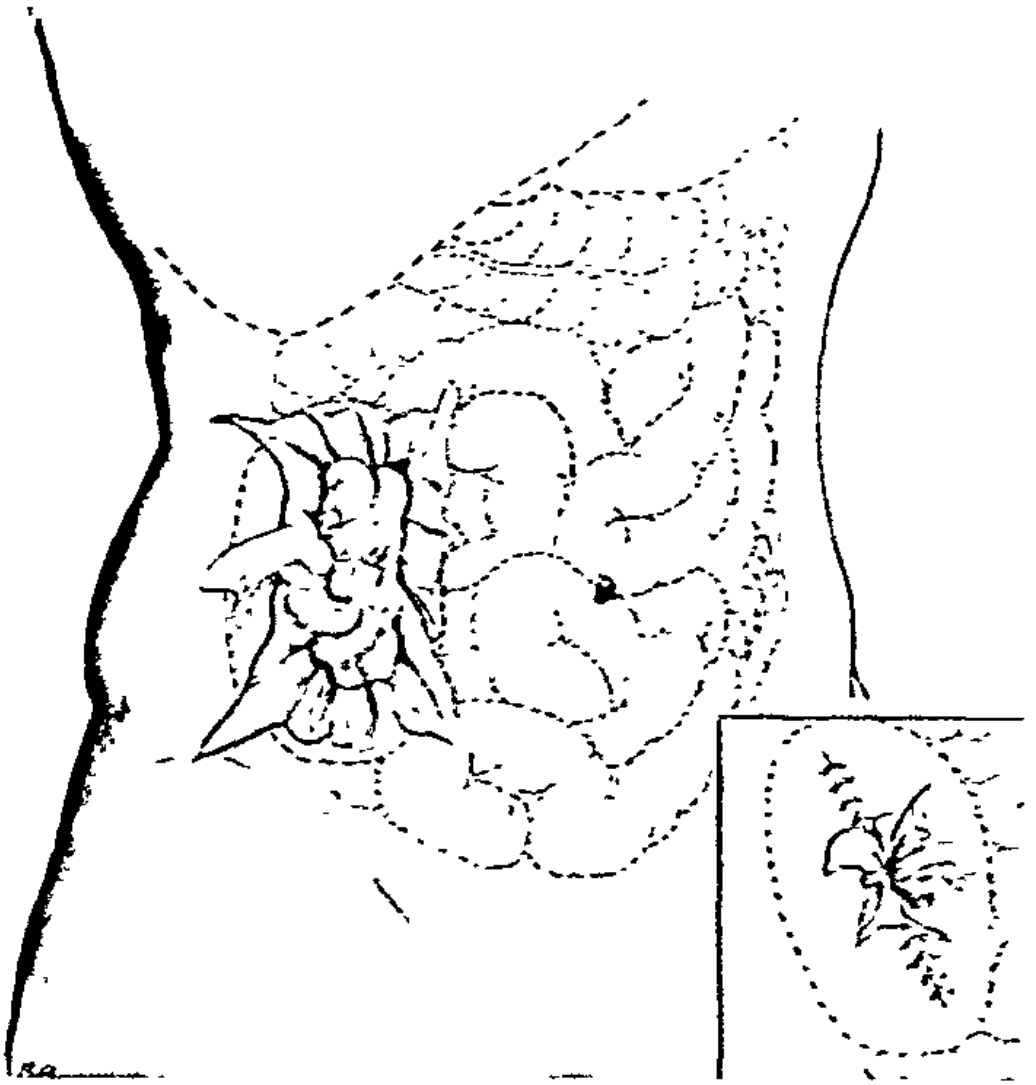

FIG. 322.—Diagrammatic sketch of pack after closure.

Technic.—For many years the author has used a modification of the Mikulicz pack, employing a sheet of rubber dam into which a large fold of gauze is packed. This may be applied in two ways, depending upon the size and shape of the area to be covered: (1) A large square sheet of rubber dam is placed against an unperitonealized area and packed with a long guaze fold until the cavity formed by the removal of a mass is filled with the bulk of the pack (*Fig. 322*). The four edges of the rubber dam square are then gathered together and are brought out of the abdominal wound

together with the inner gauze fold (Fig. 322). The pack assumes a sac-like shape with the neck at the abdominal wall (Fig. 323). One need not be concerned about the formation of a large intra-abdominal cavity with a relatively narrow opening, since it collapses rapidly within a few days after the entire pack is removed (2) In the case of a deep, narrow, unperitonealized area, one edge of a rectangular piece of rubber dam is

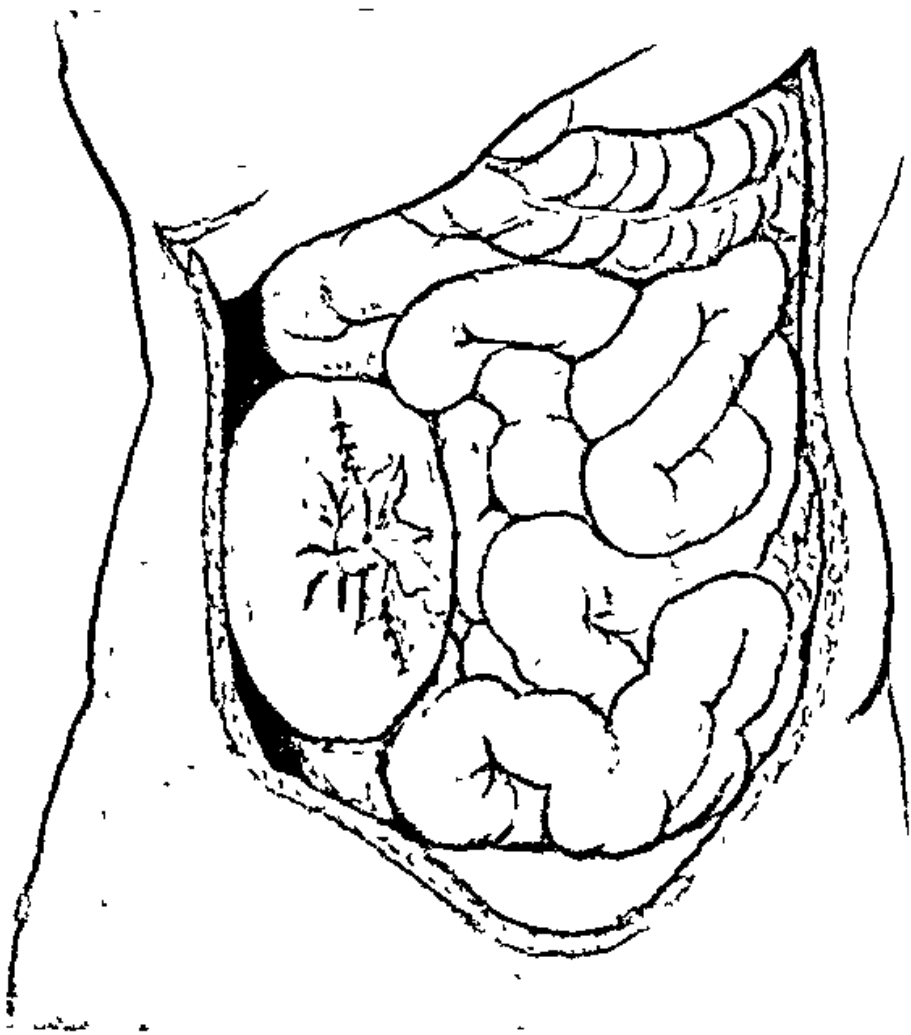

Fig 323 —Diagrammatic sketch of pack placed within abdomen

placed into the bottom of the area and folded over gauze packing, forming in appearance a large cigarette drain.

In each case the inner gauze packing is removed gradually, beginning on the third or fourth postoperative day The last portions of the pack and the rubber dam are usually removed between the eighth and the eleventh postoperative day A large rubber tube or catheter is placed into the cavity formed by the pack, and irrigations are carried out as often as necessary until it closes With careful postoperative attention, such

cavities assume the shape of vertical sinuses within a week, and the wounds are entirely healed in six to ten weeks

Uses.—We have found this type of pack of greatest value in two groups of cases: regional enteritis, especially those cases with enterocutaneous fistulas, and neoplasms of the sigmoid colon and the splenic and hepatic flexures.

At operation in regional enteritis with fistula formation one nearly always finds a densely adherent mass formed by loops of small intestine and often by the ascending colon. Extensive mobilization is necessary, leaving a large raw surface in the right lower abdomen. Furthermore, some degree of contamination is almost unavoidable in the dissection of the sinus tracts In these cases we believe that the use of the modified Mikulicz pack leads to a smooth convalescence and frequently prevents a death which otherwise might be expected.

Neoplasms of the splenic flexure are the bane of surgery of the colon. Mobilization of the lesion is frequently difficult, and a wide area of peritoneum is denuded high in the upper left colonic gutter. It is hazardous to allow the small intestines to prolapse into the cavity formed by the dissection. In such instances, when reperitonealization is impossible a Mikulicz pack is employed routinely to fill this space. The pack is brought out through a stab incision in the left flank. With neoplasms of the hepatic flexure the same situation is frequently present.

Large, bulky, adherent carcinomas of the sigmoid colon often present difficulties. Frequently they are surrounded by severe pericolic inflammation and abscesses. A Mikulicz pack is the answer to the question of handling the denuded and infected surface.

Comment.—The omentum often can be employed to cover denuded intra-abdominal surface. When its use is feasible no problem exists. In many instances, however, the omentum is short or rudimentary or has to be partially or completely removed in cases of malignant disease. Even when the omentum is well developed, it is sometimes difficult to *use it satisfactorily in covering a large area, especially in the upper* colonic gutters. In addition, there is some risk of subsequent obstruction when the omentum is sutured to a fixed point.

The modified Mikulicz pack accomplishes several things simultaneously. First, it serves as a framework for the immediate formation of a protective wall of granulating tissue. It limits the spread of infection from a given area by establishing a counter-reaction in which the surrounding viscera adhere and seal off the general peritoneal cavity. Second, it prevents the contact of the small intestines with an unperitonealized surface during the period in which the peritoneum is reacting to the trauma of

mobilization and of combating the infection Third, the pack acts as a drain. During the first few postoperative days, large quantities of serosanguineous fluid saturate the dressings. This fluid escapes about the imbrications of the rubber dam and serves to provide continuous irrigation. The central gauze packing acts only as bulk and has little to do with drainage.

When the pack is removed entirely on the eighth to the eleventh postoperative day, a clean, pliable, granulating surface remains. There is practically no retention of purulent fluid at the bottom of the cavity.

When confronted with an adherent inflammatory mass, the surgeon frequently has to decide whether to proceed with an extensive mobilization or to be content with a palliative procedure The risks of the first alternative are greatly lessened by the use of the Mikulicz pack, and more patients may be given a chance for cure We are certain that the pack has saved the lives of many patients who would have died of peritonitis and obstruction without it

We have not observed any of the disadvantages of the pack mentioned in the literature No hernias of the abdominal wound have been observed at the point of exit of the pack This we attribute to the use of alloy steel wire in wound closure No enterocutaneous fistulas have occurred which could be attributed to its use There have been no residual abscesses or persistent sinuses. These must be guarded against by daily postoperative attention to the wound until the sinuses are completely filled in.

The combination of a well-prepared patient, decompression of the ileum by Miller-Abbott tube, the use of the Mikulicz pack when indicated, and the use of steel wire figure-of-eight sutures to prevent infection and disruption, I feel confident, permits extension of operability and reduces mortality considerably.

RESECTION OF RIGHT COLON

I have had no experience with the modified Mikulicz operation or obstructive resection on the right colon. It has been recently advocated by Lahey.[11,12] If it lowers the mortality over the other operations by a considerable percentage it will naturally become the method of choice.

The classical two-stage procedure is the side-to-side anastomosis between the ileum and transverse colon and the resection of the right colon at a later date. The objections are: (1) a person is running the risk of accidental death twice instead of once; (2) the hospital stay is greatly increased; (3) complications such as penumonia, embolism, phlebitis, and infected wounds may delay or actually defer indefinitely the completion of the second stage procedure. Therefore, I employ this method only in cases where there is obstruction or perforation of the growth.

OPERATION ON THE TRANSVERSE COLON

There is a variety of satisfactory procedures for operation on the transverse colon. Ordinarily mobilization is easy, and the blood supply is good. Mayo and Simpson[13] report a mortality of 11.1 per cent in resection and primary anastomosis in contrast to 20 per cent mortality in ninety-five cases of extraperitoneal resection. In the past it has also been my choice. In my own cases there was a mortality of 10 per cent. In the one-stage procedure with resection, performed in the manner best suited to the case, I believe it is important to carry out a complementary tube cecostomy. This is simple to do through a McBurney incision. It will lower mortality and morbidity and does not prolong hospital stay, for if the tube is removed on the fifth or sixth day the stoma will be closed by the time the patient is discharged from the hospital. In cases of marked obstruction, which generally is not the rule, the tube cecostomy should be performed first under local anesthesia, followed in a week by resection. I thought my own mortality rate could be improved upon, and for that reason I am trying a series of Rankin obstructive resections. I have reason to believe that the mortality will be considerably lower.

If the obstructive resection technic is employed it is better to make the incision through the rectus muscle, right or left, according to the location of the lesion. The application of the spur clamp is safer, and in the closure of the stoma a better abdominal wall will result with less danger of weakness or definite hernia.

A lesion at the splenic flexure presents more difficulty than in any other segment of the colon. It generally lies very high and is frequently adherent to the spleen. In its mobilization the capsule of the spleen will often tear and give rise to very troublesome bleeding. In two of our cases the spleen had to be removed before operation could be completed. In another case a gauze or Milkulicz pack had to be placed tightly against it. I believe the obstructive resection is the best procedure in such cases, and a left costal border incision rather than a left rectus incision facilitates the operation.

RESECTION OF DESCENDING COLON AND SIGMOID

Until 1938 I favored resection of the descending colon and sigmoid in the one stage procedure, with end-to-end anastomosis and frequently with the tube colostomy above the growth or tube cecostomy, the present so-called primary anastomosis. The mortality in this group, which included operations on the descending colon and sigmoid in 128 cases, was 14 per cent. Even though this figure compared favorably with other statistics, I felt that it could be improved upon. I had objected to the Mikulicz type of resection because of the frequent postoperative hernias,

and I had seen many cases of recurrence in the scar, the cause of which was obvious. It seemed to me that the mortality from this operation was too high. Consequently, I started a series of the Rankin modification of Mikulicz's procedure. It seemed to me that a more radical operation could be performed with this method than with resection and anastomosis This could not be accomplished by the Mikulicz procedure because sufficient mesentery was not removed and local recurrence was too frequent. From January 1940 to July 1944 the series totalled 117 cases, sixty-one of which involved the left colon The mortality was six cases, or 5 per cent. This definite drop in mortality seems to justify continuance of the procedure in preference to others. Spontaneous closure of the colostomy occurred in eleven cases, or 14 per cent The total hospital stay in the entire group of cases averaged twenty-eight days. This included hospitalization for preoperative treatment in all cases, in ten of which a cecostomy was performed for obstruction, and for closure of the colostomy, the latter averag ng eight days. It was not necessary to perform a second operation for closure in any case

THE RECTOSIGMOID

In the literature there is no apparent unanimity of opinion as to what constitutes the rectosigmoid I identify it as the junction between the rectum and the sigmoid If the rectum is 5 inches long, the rectosigmoid should be a small segment of bowel beginning at about the peritoneal reflection and extending proximally for not more than 2 inches Most lesions at this point obviously cannot be exteriorized, yet one frequently reads about the Mikulicz operation for rectosigmoidal cancer Obviously they are speaking about the sigmoid or pelvic colon As a working basis I consider a lesion whose lower edge borders on the peritoneal reflection, or a segment 2 inches above it, as the rectosigmoid and subject it to the same operation as those performed for carcinoma of the rectum Lesions higher than this are termed sigmoid Elimination of colostomy has been a dream since time immemorial.

Dixon[14] has been advocating resection and end-to-end suture on lower lesions, even those bordering on or below the peritoneal reflection, after a colostomy has been made in preparation Babcock[15] has been recommending proctosigmoidectomy, with the primary purpose of constructing a perineal anus and offering some attempt at muscular control. Time alone will tell whether the mortality, morbidity and curability justify the procedure. In the past it certainly has been untenable

CARCINOMA OF THE RECTUM

My views upon the choice of surgical procedure for cancer of the rectum have long been known. As I first believed with firm conviction,

even though with temerity, I am now more than ever convinced that the procedure of choice for this lesion and those in the rectosigmoid, as I interpret it, is the one-stage abdominoperineal resection, the Miles operation. It offers the best hope of cure, the lowest mortality and morbidity from the standpoint of local recurrence, and the greatest palliation of all procedures. In a series of over 1000 cases the mortality is 7.2 per cent. From October, 1941, until June, 1943, we completed 137 consecutive cases without a single fatality. It must be apparent from this number that bad risks as well as good risks were given a chance for recovery. Eight patients had involvement of the liver at the time of operation; twenty-five had arteriosclerotic heart disease with hypertension; five had coronary heart disease, and four had diabetes. Twenty-seven had had previous abdominal operation, which, in general, is a complicating factor. The total hospital stay in this entire group averaged twenty-two and one-half days. In 1946 and 1947 we completed another series of 169 consecutive cases without mortality. The patients were prepared preoperatively at home, and the hospital stay was fifteen days. There were no disruptions, and only three abdominal wounds became infected. Attention has been called to this before, and the improvement has been attributed to the figure-of-eight alloy steel wire closure.[16]

Elimination of infection reduces mortality and morbidity to a very low percentage, which in turn increases the scope of operability. To include in that percentage patients with metastatic lesions will, of course, decrease the curability rate. That makes little difference. We will make more people comfortable for a longer period of time.

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FAMILIAL POLYPOSIS OF THE COLON: DIAGNOSIS AND TREATMENT

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Satisfactory end results can be obtained by operation in selected cases of polyposis of the colon. Familial polyposis, or multiple adenomatosis, of the colon is the hereditary occurrence of true polyps, or adenomas, throughout the colon and rectum. Polyps are usually scattered in profusion from the anus to the cecum and may be sessile or pedunculated and of all sizes. The condition should not be confused with pseudopolyposis of the rectum and colon secondary to inflammatory conditions nor with that of two or more polyps in one or several segments of the colon.

A satisfactory classification of true polyps of the colon and rectum has been suggested by Erdmann and Morris[1] (1925), who divided them into two groups: (1) adolescent (familial, disseminated) type, polypi that occur throughout the colon by the thousands, and (2) adult (acquired) type, papillomas or adenomas that may occur singly or in groups in the colon or rectum of children or adults

Pseudopolyposis, or that condition simulating polyposis, occurs as the end result of some diffuse inflammatory disease such as chronic nonspecific ulcerative colitis or tuberculosis of the bowel. These polyps are not true adenomas They consist of islands of intestinal mucosa that lie between areas of destroyed mucosa and become more prominent as healing and scarring of the underlying tissue takes place. In contrast, there is no notable tendency to malignant degeneration, while in familial polyposis quite the opposite is true. This paper deals only with the adolescent or familial type.

It is not always easy to differentiate between the two types. The history alone may not be sufficient to rule out pseudopolyposis secondary to ulcerative colitis, as the symptoms of both types may be similar. Bloody diarrhea, weight loss, and anemia are common to each. Proctoscopic examination also may not clearly differentiate the two, as in both conditions the rectum may appear filled with a mass of small polyps. Roentgenograms of the colon are helpful in these cases. In pseudopolyposis evidence of old inflammatory disease of the colon is apparent, as there is contraction of the lumen and shortening of the colon with loss of haustrations (Fig. 324).

The diagnosis of the disease is usually not difficult and most often is

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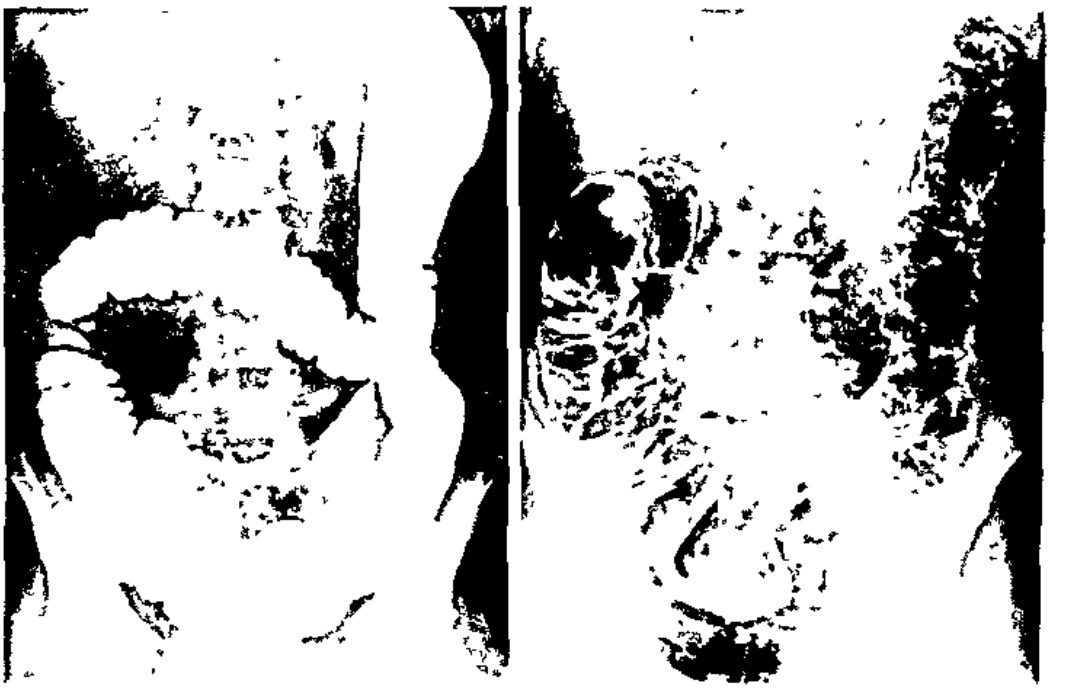
only to have the condition become apparent when double air contrast technic was used (Fig. 325).

Digital examination usually reveals a thickened mucosa, and in some cases multiple soft nodules can actually be felt. Proctoscopic examination usually shows the rectum and lower sigmoid colon to be the seat of hundreds of small adenomas of different sizes. They may range from the size of a rice kernel to a cherry. Some patients have complained of prolapse of the polyps from the rectum. It is not uncommon for the patient



A B

FIG 325 (Case III) —*A*, Polyposis of colon in a 27 year old man Upon examination with barium enema technic the colon was interpreted as normal except for serration of the margin of the transverse colon and incomplete filling of the splenic flexure. *B*, Same patient with double air contrast technic. Hundreds of polyps are demonstrated as small round filling defects Note ring shadow at splenic flexure caused by clinging of barium to sides of a polyp

to observe at one time or another the passage of the polyps in the stool after a cathartic or a severe bout of diarrhea.

In patients with polyposis it is always uncertain whether a carcinoma is present at the time of examination or whether one will develop during the course of surgical treatment. In our own series of twenty-two cases, carcinoma was present in eight patients at the time of their first examination Three of these were admitted because of intestinal obstruction from the neoplasm and two had visible cancers of the rectum and lower sigmoid colon Two other patients apparently developed carcinoma of the

made by proctoscopic examination at the first visit. Roentgenograms will then help to confirm the diagnosis of polyps in the rest of the colon. There must be close liaison between examiner and radiologist, because air injection is almost always necessary to demonstrate diffuse polyposis of the colon. Without air injection the roentgenologic examination may be

FIG. 324.—Pseudopolyposis in a child with late chronic ulcerative colitis. Note shortening of colon with loss of haustrations, decreased distention of bowel, and wide destruction of mucosa with pseudopolyp formation.

reported as normal, or as is so often the case, "inadequate preparation," or "unsatisfactory due to presence of fecal material." Polyps of all sizes cause a certain haziness on the silhouette, often due to the presence of fecal material which produces inadequate visualization on the roentgenogram. As many as six films of the colon have been made on one patient over a period of four years without a definite roentgenologic diagnosis,

than for any other reason. It was not until Harrison Cripps[5] presented his observations before the Pathological Society of London in 1822 that the familial character of the disease was recognized. Cripps described two patients, a brother, aged 9, and a sister, aged 17, in whom masses of polypi protruded from the rectum. In his description of the girl he stated, "The most extraordinary and interesting part of the case consisted in the fact that she was the sister of the patient whose case we have just described". He also called attention to its rarity by stating that there was no record of it in the "transactions" of the Pathological Society of London.

Lockhart-Mummery[6] in 1925 and McKenney[7] in 1936 demonstrated inheritance from one generation to the next, and McKenney studied polyposis through three generations. The families studied by Lockhart-Mummery were further followed and reported by Dukes in 1930. It has been conclusively shown that the disease can be transmitted by both the male (Dukes) and the female (McKenney) and that it is inherited as a Mendelian dominant.

The symptoms of the disease at the time the patient is seen depend entirely on the status of the polyps; symptoms may be influenced by (1) the prevalence of polyps in the lower colon and rectum, (2) whether or not ulceration and bleeding are present, (3) the presence of an engrafted inflammatory process, and (4) the presence of malignancy.

As the bulk of polyps increases in the lower colon and rectum, change in the bowel habit may supervene. There may be a frequent discharge of mucus and blood with rectal discomfort. The polyps ulcerate and bleed and often break off and pass with the stool. Some patients present as their main complaint frank rectal hemorrhage. Sometimes the bleeding is insidious and so constant that a severe secondary anemia is present. All too often the symptoms are due to a malignancy that has developed in the colon or rectum. This is manifest by the usual symptoms of bowel-habit change, blood and mucus, diarrhea, and finally frank obstruction.

Although a few of the patients state that they have had loose stools all of their lives, most can determine the exact date of onset of symptoms. These, for the most part, are loose stools with blood, usually appearing during the summer months or during an epidemic of food poisoning or diarrhea. It would seem that some diffuse inflammatory process throughout the polyp-laden colon is often responsible for the onset of symptoms. That a chronic inflammatory process is present is evident by the marked adenopathy often found in the mesentery of the colon at the time of operation.

The progress of the disease from the appearance of the polyps to the onset of symptoms is interesting. Diffuse polyposis of the colon and

rectum can be present entirely without symptoms. The diagnosis in one member of a family with symptoms has often led to the same findings in another without symptoms One of our own patients, a girl of 12 years, was operated upon for acute appendicitis and died of fulminating peritonitis (1936). Postmortem examination revealed the colon and rectum to be the seat of a diffuse polyposis There had been no symptoms referable to the colon or rectum prior to operation

Polyps are not always uniformly distributed in the colon and rectum, and a carcinoma may be present in a polyp-laden colon with a few adenomas in the rectum Primary examination of the rectum may reveal few or none at all, while at some later date countless polyps may be noted Dukes (1947) has observed the development of polyps in a patient who at the first examination was certified free of them.

At first glance it would appear that, in the presence of the hereditary tendency, polyps might appear any time Although this may be partly true, there is evidence that the polyps appear during adolescence and grow progressively. No one as yet has reported the presence of polyposis at birth; however, McKenney (1936), in the study of one family so affected, observed polyps in various stages of growth in four children at the ages of 2, 5, 9, and 11 years, respectively The polyps were graded in size according to the age, the largest being present in the oldest child With these facts in mind one should not dismiss completely any member of a family in whom polyposis is not present after one examination

The only treatment for the disease is surgical As has been demonstrated many times, the high incidence of malignant degeneration in these cases demands radical treatment because we believe that if these patients live long enough, malignancy will develop in one or more polyps It is not unusual to find two cancers present at the time of operation Some patients have had two or more resections for carcinoma of the colon and rectum This was the case in one of our own patients reported here.

CASE REPORTS

Case I.—A man, aged 26, was admitted in September 1942, with the complaints of blood and mucus in the stool and occasional abdominal cramps and diarrhea These symptoms had been present intermittently since the age of 15 years A resection of the transverse colon for carcinoma had been performed elsewhere one and one-half years prior to admission No record of proctosigmoidoscopic or roentgenologic examination of the colon was available

Physical examination revealed a slim, underweight, asthenic youth A roentgenogram of the colon showed two polyps in the descending colon A laparotomy and a transcolonic polypectomy were performed Four months later the patient returned to the clinic complaining of loose stools and blood from the rectum,

together with a small tumor in the scar of the old left rectus incision This was excised and proved to be a desmoid tumor of the fascia. At this time proctosigmoidoscopic examination revealed several polypi of the rectum, which were then fulgurated

His health was good until eight months later, when he returned with symptoms suggesting duodenal ulcer Roentgenologic examination was negative for this condition, but roentgenograms of the colon revealed polyps in the descending colon. Another proctosigmoidoscopic examination revealed many polyps in the rectum and lower sigmoid colon. Definitive operation for polyposis of the colon and rectum was advised, but the patient failed to return until seven months later (July 1945), at which time he again reported for examination with the same complaints of bright red blood in the stool and occasional loose stools. Proctosig-

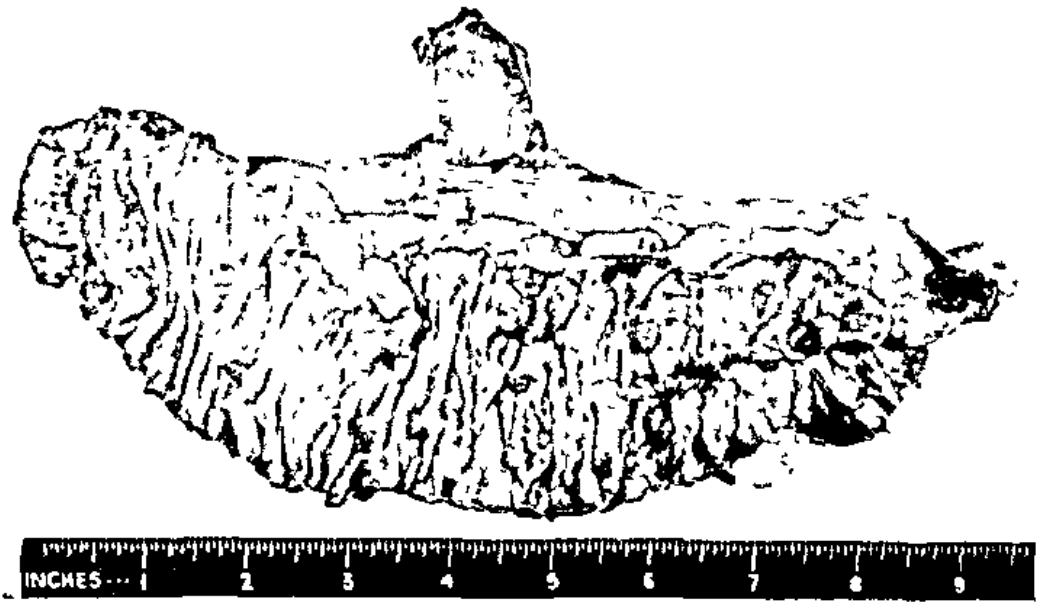


FIG 326 (Case I) —Sigmoid and portion of ascending colon removed as a second-stage procedure in May, 1947 Note adenomatous polyps beginning 2 inches above colostomy on the left.

moidoscopic examination revealed multiple polyps in the rectum, one of which appeared to be neoplastic. The lesion was fixed, and combined abdominoperineal resection was advised. Five days later the rectum and lower sigmoid were removed in one stage. At the time of operation metastatic nodes were found in the mesentery of the sigmoid colon Six months later (January 1946) the patient was symptom-free, and roentgenograms of the colon with double air contrast revealed multiple polyposis of the remaining colon The patient was again advised to have colectomy; however, he did not return until ten months after the combined abdominoperineal resection, at which time he again noted blood and mucus in the stool from the colostomy. There was no weight loss and no diarrhea. He was advised again to have the rest of the colon removed but failed to return until twenty-one months following the combined abdominoperineal resection. At this

rectum can be present entirely without symptoms. The diagnosis in one member of a family with symptoms has often led to the same findings in another without symptoms. One of our own patients, a girl of 12 years, was operated upon for acute appendicitis and died of fulminating peritonitis (1936). Postmortem examination revealed the colon and rectum to be the seat of a diffuse polyposis. There had been no symptoms referable to the colon or rectum prior to operation.

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The only treatment for the disease is surgical. As has been demonstrated many times, the high incidence of malignant degeneration in these cases demands radical treatment because we believe that if these patients live long enough, malignancy will develop in one or more polyps. It is not unusual to find two cancers present at the time of operation. Some patients have had two or more resections for carcinoma of the colon and rectum. This was the case in one of our own patients reported here.

CASE REPORTS

Case I.—A man, aged 26, was admitted in September 1942, with the complaints of blood and mucus in the stool and occasional abdominal cramps and diarrhea. These symptoms had been present intermittently since the age of 15 years. A resection of the transverse colon for carcinoma had been performed elsewhere one and one-half years prior to admission. No record of proctosigmoidoscopic or roentgenologic examination of the colon was available.

Physical examination revealed a slim, underweight, asthenic youth. A roentgenogram of the colon showed two polyps in the descending colon. A laparotomy and a transcolonic polypectomy were performed. Four months later the patient returned to the clinic complaining of loose stools and blood from the rectum.

the next four years. Ileosigmoidostomy and colectomy were again proposed, and when she was assured that a stoma would not be necessary she consented to the procedure. The ileosigmoidostomy and colectomy were carried out in two stages, and the colon presented the usual picture of universal polyposis. No evidence of carcinoma was found, although four years had been lost in the process. A year later several small adenomas were fulgurated in the rectum, and the patient was well, having gained 40 pounds in the interim. Two years later she was found to have a mass in the left lower section of the abdomen and severe anemia. Exploratory operation revealed a mass of retroperitoneal nodes in the sacral and lumbar regions, undoubtedly metastatic extension from a small carcinoma of the previously removed colon. At the time of fulguration there was no evidence of carcinoma in the rectum or lower sigmoid colon, and the terminal ileum was entirely normal. This case serves principally to show that much valuable time was lost between 1926 and 1931 and that, had the treatment been consented to earlier, the outcome might have been more satisfactory.

TREATMENT

In the treatment of familial polyposis, two conditions must be met: (1) removal of the potential cancer-bearing bowel and (2) restoration of the patient to a normal life. The primary object of operation is to prevent the occurrence of malignancy, and if this can be accomplished, together with assurance to the patient that he will not have an artificial stoma, a great obstacle to the treatment can be removed.

The ideal treatment is obliteration in stages of the polyps from the anus to the lower five inches of the sigmoid colon, then ileosigmoidostomy (Fig. 327, *A*) and later colectomy performed in stages. The end object is removal of all of the potential neoplastic area except that which can be viewed through the proctoscope (Fig. 327, *B*).

Preparation usually consists of castor oil taken the day before entry into the hospital. Cleansing enemas suffice to clean out the rectum and the lower sigmoid colon. The polypi should be fulgurated lightly, taking care with those above the peritoneal reflection, to avoid damage to the bowel wall. Occasionally strictures may occur at the rectosigmoid, but this may be overcome by dilatation at the time of fulguration at each visit. After completion of fulguration of the polyps to a distance of 10 inches above the anus, ileosigmoidostomy can be performed. A suitable time interval should be observed to allow for the edema of fulguration to subside. The anastomosis between the ileum and the sigmoid colon is usually made about 4 inches above the peritoneal reflection. Depending on the length of the mesenteries of the sigmoid and the ileum, a side-to-side, isoperistaltic, open type of anastomosis is constructed. The Harris or Miller-Abbott tube is used in all cases and is left in place until the bowels are moving satisfactorily. Diarrhea is present in most cases for the

first two weeks, but this usually resolves into two to four movements a day in the average case, depending on the diet and personal factors.

At the second stage of the procedure, the ileum is divided about an inch distal to the anastomosis and the colon is removed over to the mid-transverse portion The distal stump is brought out through a stab wound in the upper left rectus muscle. The last operation consists in removal of the left colon down to within 1 inch of the anastomosis. At this point the ileosigmoidostomy may be viewed directly through the open colon and any remaining polyps fulgurated lightly with the ball tip

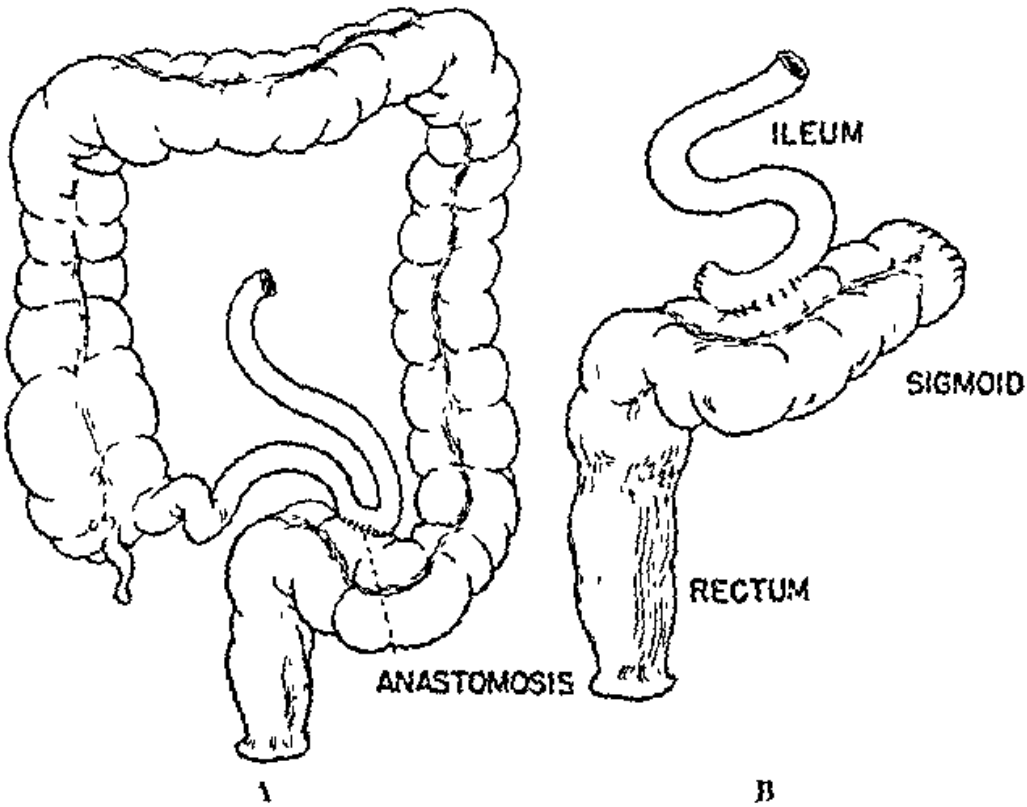

FIG 327.—*A*, First stage ileosigmoidostomy *B*, Surgery completed Colon removed down to anastomosis

In the thin patient who is in good health, the whole colon may be removed in one stage, although the weight gain following ileosigmoidostomy often prevents this

Occasionally patients are examined for the first time with so many polyps in the rectum that there is no normal mucosa present or with a neoplasm already present This has occurred in two of our recent cases In a woman of 62 years there was virtually no normal mucosa remaining in the rectum and, after ileostomy and right colectomy in one stage, combined abdominoperineal resection and left colectomy were performed in two stages She is now well and, being in the older age group, does not object to the permanent ileostomy.

The following two case reports are those of a brother and sister who have completed their surgical treatment.

CASE III.—A man, 27 years of age, entered the Cleveland Clinic in July, 1945, with the complaint of episodes of loose stools with occasional blood for the past four or five years. Prior to admission he had been examined elsewhere and told that the rectum was filled with small tumors. Physical examination was negative except for palpable small tumors in the rectum. Proctosigmoidoscopic examination showed many small rectal polyps of different sizes, some of which were sessile and others pedunculated Air contrast studies revealed disseminated polyposis The patient was advised to have fulguration in stages of the rectal and lower sigmoid polyps and colectomy in stages after ileosigmoidostomy. Family history disclosed that his mother had died at the age of 48 of cancer of the rectum, one uncle and one aunt had died of bowel complaints, and two sisters had occasional diarrhea and blood in the stools

In July, 1945, forty to fifty small polyps of the rectum and lower sigmoid colon were fulgurated. One month later many small polyps of the colon and rectum were again fulgurated. Three months following the original examination, proctosigmoidoscopic examination did not demonstrate polyps in the rectum or lower sigmoid colon. At this time an ileosigmoidostomy was performed. Four months later (April 1946) a right colectomy was performed, and six months later the left colectomy was completed. Since that time the patient has gained 40 pounds in weight and has been completely well. Proctosigmoidoscopic examination at six month intervals since the completion of the last stage has not revealed polyps up to the level of the anastomosis

Comment.—This case illustrates the advantage of prompt surgical treatment. The patient kept his hospital appointments, and surgery was completed without delay. Although the colon was filled with polyps, there was no evidence of malignancy in any portion.

CASE IV.—A woman (the sister of the patient in Case III), 39 years of age, was admitted to the Clinic in April 1947, with complaints of diarrhea and severe anemia which did not respond to treatment. The patient stated that she had had an uncontrollable diarrhea of up to twleve loose stools daily for the past eight years. She had noted occasional streaks of blood in the stool. She had been treated for severe anemia during the last five years, and at one time her hemoglobin had been 4.7 gm , with 2,800,000 red blood cells Repeated small transfusions were given during this period. Physical examination was essentially negative except for small palpable polyps in the rectum Proctoscopic examination revealed fifty to sixty small adenomatous polyps extending up into the lower sigmoid colon. A roentgenogram of the colon (double air contrast) revealed multiple polyposis of the colon and rectum. Fulguration of the rectum and lower sigmoid polyps with ileosigmoidostomy and total colectomy was advised (Fig. 328)

In April 1947, fifty to sixty small polyps of the rectum and lower sigmoid colon were fulgurated. Two months later several small polyps of the lower rectum

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At the second stage of the procedure, the ileum is divided about an inch distal to the anastomosis and the colon is removed over to the mid-transverse portion. The distal stump is brought out through a stab wound in the upper left rectus muscle. The last operation consists in removal of the left colon down to within 1 inch of the anastomosis. At this point the ileosigmoidostomy may be viewed directly through the open colon and any remaining polyps fulgurated lightly with the ball tip.

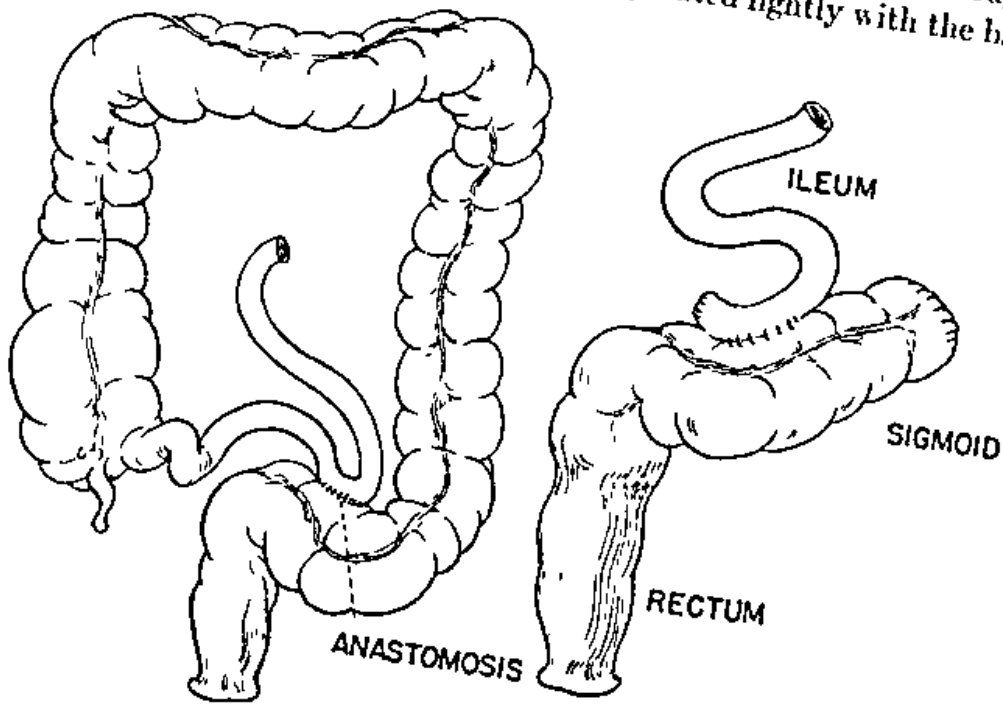

FIG. 327.—*A*, First-stage ileosigmoidostomy. *B*, Surgery completed. Colon removed down to anastomosis.

In the thin patient who is in good health, the whole colon may be removed in one stage, although the weight gain following ileosigmoidostomy often prevents this.

Occasionally patients are examined for the first time with so many polyps in the rectum that there is no normal mucosa present or with a neoplasm already present. This has occurred in two of our recent cases. In a woman of 62 years there was virtually no normal mucosa remaining in the rectum and, after ileostomy and right colectomy in one stage, combined abdominoperineal resection and left colectomy were performed in two stages. She is now well and, being in the older age group, does not object to the permanent ileostomy.

entire colon down to the anastomosis; however, she had gained so much weight since the ileosigmoidostomy that this was not feasible. In February 1948, a left colectomy was performed. A small carcinoma was found (Fig. 329).

Comment.—This patient was older than her brother at the time of diagnosis and perhaps a more likely candidate for the small carcinoma that was found in the descending colon at the time of the last stage procedure. The finding of the malignant neoplasm demonstrates the danger of delay in treatment.

SUMMARY

Since 1926 only twenty-two patients with familial polyposis of the colon have been seen in the Division of Surgery of the Cleveland Clinic. Seven declined surgical treatment, and seven completed treatment. Of the seven completed cases six patients are well and living normal lives, while one died of metastasis five years after operation. Of the six living patients, carcinoma was found in three, in the colon in one, and in the rectum in two Of these six patients four had multiple fulgurations of the rectum with ileosigmoidostomy and colectomy in stages. The remaining two had abdominoperineal resections of the rectum performed first, followed by total colectomy because of the presence of carcinoma of the rectum.

Total Cases

Sex. males, 14, females, 8
Age extremes: youngest 12 years; oldest 62 years
Average age, 37 years
Age distribution: below 40 years, 16, over 40 years, 6
Number with cancer at original visit, 8
Declined treatment, 7
Completed surgery, 7
Family history, 9
Principal symptoms on admission:
- Diarrhea without blood, 2
- Diarrhea with blood, 16
- Diarrhea and blood (obstructed), 4
- Frank rectal hemorrhage, 2

The eight remaining patients are known to have died from cancer.

Polyposis is a condition in which the end result without treatment can accurately be predicted. The surgical result is excellent when certain specifications are met, yet few of the patients examined submit to definitive operation because of their reluctance to accept such a radical program. Family history, proctoscopic examination, and air contrast studies of the colon should be sufficient for diagnosis.

A prediction of the patient's future, in the event that he refuses or

defers operation, should be made Pointing out a related death in the family from cancer of the bowel is often a stimulus to decision Fulguration, ileosigmoidostomy, and colectomy should be performed in suitable cases as soon as possible We believe that the period from the first fulguration of polyps until completion of colectomy could easily be reduced to six months

After colectomy, proctoscopic examinations should be made at intervals of three to six months to discover whether or not new polyps have developed Immediate treatment usually saves the patient from malignant degeneration in newly recurring polyps

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NEUROLOGIC LESIONS SIMULATING INTRA-ABDOMINAL DISEASE

A. T. Bunts, M.D., F.A.C.S.

When confronted with the problem of determining the cause of abdominal pain most clinicians usually first consider some organic lesion or dysfunction of the abdominal viscera as the source of the symptom. From a statistical standpoint it is quite probable that such an attitude is sound and warranted by the final diagnosis. Inflammation and neoplastic disease, ulceration of the gastrointestinal tract, obstructive lesions of tubular organs, biliary and renal calculi, an irritable colon and other intra-abdominal conditions are more common than diseases of the nervous system as causes of abdominal pain.

All too frequently, however, patients are subjected to abdominal operations for the relief of pain which originates, not within the abdominal viscera, but in some irritative lesion of the sensory nerves which supply the abdominal wall. In the hope of minimizing the frequency of such procedures it seems worth while to consider the neural mechanisms of abdominal pain and the various neurologic diseases which may cause such pain.

PHYSIOLOGY

As pointed out by Wolff and Wolf,[1] painful impulses are received at specific nerve terminals scattered throughout the skin, subcutaneous structures and viscera. Thence they pass over myelinated and nonmyelinated nerve fibers to the posterior root ganglia, either directly by way of somatic nerves or indirectly via sympathetic pathways and white rami communicantes. After entering the spinal cord by way of the posterior nerve roots, painful impulses are transferred to a second neuron whose cell body is in the posterior horn of the grey matter. From here they are carried in the anterior commissure to the opposite side of the cord and ascend in the lateral spinothalamic tract to the brain.

Painful impulses arising in the abdominal viscera travel in splanchnic sympathetic pathways and enter the cord through the posterior spinal nerve roots of the seventh thoracic to the first lumbar nerves inclusively. Such impulses from the stomach, pancreas, liver and biliary tracts appear to enter the cord in the seventh to ninth thoracic segments and are experienced in the epigastric region. Pain from the gall bladder is usually localized in the distribution of the ninth thoracic nerve, either

From the Cleveland Clinic, Cleveland, Ohio

anteriorly beneath the right costal margin or posteriorly at the angle of the scapula. From the small intestine painful impulses eventually reach the cord through the ninth to the eleventh thoracic posterior nerve roots. According to Wolff and Wolf,[1] "The innervation of the colon is not clearly understood. It is probably mainly supplied by afferent fibers through its mesenteries from the lower thoracic and upper lumbar segmental nerves without involvement of sympathetic or parasympathetic pathways. The rectum, however, does receive afferent nerves through the parasympathetic rami from S-2 to S-4." Painful impulses from the kidneys and ureters reach the cord via the tenth thoracic to the first lumbar posterior spinal nerve roots. From the fundus uteri painful impulses enter the cord from the tenth thoracic to the first lumbar segments, and from the Fallopian tubes and ovaries they reach the cord at the tenth thoracic level.

DIFFERENTIAL DIAGNOSIS

Visceral pain is usually characterized by a deep, aching quality and is referred to the surface of the body in those areas which are innervated from segments of the cord which have received the original painful impulse from the viscus. The spread of such excitation within the spinal cord may result in a more diffuse reference of pain to the body surface. Hyperalgesia or hyperesthesia of the skin may be present in these areas.

From these considerations it should not be difficult to appreciate the fact that lesions which involve the thoracolumbar posterior spinal nerve roots, the posterior nerve root ganglia, or the peripheral sensory nerves themselves may give rise to pain simulating that which is the result of disease or dysfunction of intra-abdominal viscera. The problem of differential diagnosis is not always easily solved. A careful clinical history will usually bring out information suggesting visceral disease, which may be confirmed or excluded by physical examination and by appropriate roentgenologic studies and laboratory tests. Many of these conditions, such as ruptured peptic ulcer, acute appendicitis and intestinal obstruction, may require urgent surgical therapy which cannot be postponed, and the surgeon cannot waste time in an effort to exclude a possible neurogenic origin for abdominal pain in such a case. Nevertheless, in cases in which there is no apparent surgical emergency and when time has permitted deliberate and careful exclusion of visceral disease, the possibility of disease of the spinal nerves which supply the abdominal wall should be considered.

Judovich and Bates,[2] for a clinical working basis, have divided ab-

dominal pain into three groups, depending upon the degree of associated tenderness:

1. Purely visceral pain, which does not include in its reaction irritation of the structures supplied by the somatic afferent nerves, i.e., the parietal peritoneum and mesentery. Local skin tenderness would be absent and areas to which the pain is referred would not be associated with tenderness.

2. Visceroparietal pain, in which the diseased viscus includes the parietal peritoneum in its reaction and in which pain, tenderness, local hyperalgesic areas of the skin and rigidity manifest themselves. This group may also have pain, tenderness and rigidity without the hyperalgesic areas.

3. Segmental pain and tenderness. Clinically, the combination of segmental pain and tenderness is usually not initiated by stimuli from diseased abdominal viscera. The findings of a painful segment in which all of the cutaneous branches are hyperalgesic as compared to opposite normal side, with absence of rigidity or other clinical findings which denote visceral disease, are usually indicative that the pain and tenderness are somatic in origin In other words, we have a syndrome of segmental neuralgia which is not often initiated by visceral stimuli.

NEUROLOGIC CONDITIONS CAUSING ABDOMINAL PAIN

Among the neurologic conditions which may give rise to abdominal pain are segmental neuralgia (intercostal neuralgia, parietal neuralgia), spinal arthritis, herpes zoster, tabes dorsalis, neuritis, spinal cord tumor, diseases of the vertebrae involving nerve roots, and meningeal disease.

Segmental Neuralgia.—Segmental neuralgia, otherwise known as intercostal neuralgia or parietal neuralgia, is a term which has been vaguely used to describe many conditions associated with pain within the distribution of nerves supplying the abdominal wall. Although the exact cause of such pain is obscure, it has been pointed out by Carnett and Bates[3] that it is usually due to some form of spinal abnormality causing inflammation about, or actual pressure on, spinal nerve roots. They were of the opinion that chronic postural trauma due to such disorders as changes in the lumbar curvature, the spinal strain of a heavy abdomen, or mild functional scoliosis due to a short leg could result in definite irritation of the emerging nerve trunks either from the inflammatory reaction or from actual bony narrowing of the intervertebral foramen. The possibility of protrusion of an intervertebral disk in the lower thoracic or upper lumbar region of the spine, although distinctly uncommon at these levels, must be borne in mind as a cause of nerve root irritation with resultant abdominal pain. The intensity and duration of segmental neuralgia may vary greatly. It may be a mild soreness or a severe, excruciating, stabbing pain similar to that of tic douloureux. It may even simulate an acute intra-abdominal catastrophe. Carnett[4] has

described certain tests by which he differentiates tenderness in the abdominal wall from tenderness in the viscera The patient raises his legs or head and shoulders from the table in order to contract his abdominal muscles, thereby protecting the underlying viscera from pressure of the palpating fingers When the abdomen is palpated or pinched while the muscles are tensed, the tenderness of a true visceral lesion is decreased or absent, while the tenderness of parietal neuralgia is unchanged and readily elicited Davis[5] reported a group of 250 children with segmental neuralgias simulating various forms of visceral disease

Spinal Arthritis.—Hypertrophic arthritis of the spine is common in patients over 40 years old and causes nerve root pressure in many cases When associated with chronic postural trauma, the symptoms are accentuated Roentgenologic examination of the spine is usually helpful in diagnosing this condition

Herpes Zoster.—Herpes zoster is an acute virus infection involving the posterior nerve root ganglia, the posterior nerve root, the peripheral nerve, the posterior horn of the grey matter of the spinal cord, and the corresponding area of skin which is supplied by the involved nerve or nerves The first local symptom is usually pain in the segment or segments involved This pain is burning or shooting in character and often severe and associated with hyperalgesia of the skin The papulovesicular eruption of the skin occurs three or four days after the onset of pain and follows a zonal pattern in the involved dermatomes Herpes zoster is usually unilateral During the pre-eruptive stage of the disease the pain may easily be mistaken for that of acute appendicitis or other intra-abdominal disease, but the appearance of the vesicular eruption is so characteristic that it can hardly be mistaken After subsidence of the eruption, small permanent scars usually remain in the skin and the pain gradually subsides The skin may become partially or completely analgesic, though pain and hyperesthesia sometimes persist for months or years

Tabes Dorsalis.—Tabes dorsalis is often accompanied by "lightning pains" in its early stages Such pains are severe, paroxysmal, stabbing, and of short duration and are attributable to an irritable state of the degenerating sensory fibers in the posterior nerve roots So-called "tabetic crises" are severe paroxysms of pain due to increased motility of a hollow viscus, which is probably the result of a disorder of autonomic afferent impulses. The gastric crisis is the commonest of these disturbances and is characterized by attacks of epigastric pain associated with severe vomiting A previous history of luetic infection, together with the finding of certain abnormal neurologic signs and positive tests in the blood or

cerebrospinal fluid, usually clarifies the diagnosis. Loss of appreciation of vibration, pupillary changes, diminished or absent tendon reflexes and ataxia are commonly present in tabes dorsalis.

Neuritis.—Neuritis, inflammation of a nerve, may involve any of the nerves which supply the abdominal wall, although it is much less common in these nerves than in those of the extremities. It is characterized by persistent or paroxysmal pain, associated frequently with cutaneous tenderness in the area supplied by the nerve. The inflammation may be the result of bacterial toxins or virus infection, metabolic disorders such as diabetes, or chemical poisons such as lead or alcohol. Butsch and Harberson[5] reported their observations on fifty patients with acute pain and tenderness in the right lower quadrant of the abdomen simulating appendicitis. Thirteen of these patients were operated upon, and no intra-abdominal disease was found in any case. Observation of the progress of the remaining thirty-seven patients did not suggest appendicitis. They considered the condition to be an acute virus infection with nerve root involvement.

Spinal Cord Tumors.—Spinal cord tumors frequently give rise to nerve root pain and, when situated in the thoracic region of the spine, may cause abdominal pain by irritation of the nerve roots which supply the abdominal wall. A neurofibroma arising from the sheath of a posterior nerve root or a meningioma compressing a nerve root often causes severe lancinating "root pain," which may simulate biliary colic, renal or ureteral colic, or acute appendicitis. In almost 70 per cent of such tumors the initial symptom is pain, and signs of spinal cord compression may not appear until later as the neoplasm expands. Localized pain and tenderness in the spine over the site of the tumor may also be present. Increased pain on coughing, sneezing, or straining at defecation is characteristic of such tumors, and the pain often seems to be worse at night. Extradural tumors such as sarcomas may also cause pain, but intramedullary tumors are rarely accompanied by pain until late in their development after signs of spinal cord disease are apparent. Eventually all spinal cord tumors produce signs of involvement or compression of the cord, such as motor weakness of the legs, sensory loss below the level of the neoplasm, abnormal reflexes, and disturbances in control of the rectal and vesical sphincters. A study of the dynamics of the cerebrospinal fluid and its total protein content often reveals a complete or partial spinal subarachnoid block and an increase in protein in the fluid below the level of a tumor. Roentgenologic examination of the spine, including myelography, is often helpful in localizing a spinal cord tumor.

Diseases of the Vertebrae.—Diseases of the vertebrae which may

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UROLOGIC INVESTIGATION OF ABDOMINAL MASSES

WILLIAM J. ENGEL, M.D., F.A.C.S.

THE presence of an abdominal mass is a frequent diagnostic challenge which even the most astute clinician is rarely able to meet without the aid of special studies. Since the majority of these masses occur in the flank and the side of the abdomen, urologic examination is of great value in determining their location and nature. Too frequently this study is omitted.

When presented with an abdominal mass, a detailed history and a careful physical examination may supply important evidence in its identification. For example, pain suggests an inflammatory or obstructive lesion; fever denotes infection, although in exceptional cases it may occur with degenerating neoplasms; rapid weight loss suggests cancer; hematuria suggests a renal tumor, and, similarly, predominant gastrointestinal complaints suggest liver or gallbladder disease. Not infrequently, however, these masses may be entirely asymptomatic and discovered only on routine examination, and in such cases the physician must depend entirely upon objective findings.

Palpation of the mass supplies certain essential information. Preliminary localization is thus determined, as is the degree of mobility, fixation, or tenderness. For masses in the flank bimanual ballottement is valuable (Fig 330). This method is similar to that employed in obstetrics. The posterior hand exerts a quick upward thrust against the mass, which is immediately felt by the hand held on the abdomen, and the later rebound of the mass is again felt posteriorly. A positive sign is highly indicative of a retroperitoneal mass, while, conversely, absence of the sign points to intraperitoneal location. By careful palpation one must also differentiate between cystic and solid masses and determine their contour. Fitting these findings with later roentgenologic and laboratory studies, one arrives at a correct diagnosis.

In considering these masses one must inquire: (1) Is it intraperitoneal or retroperitoneal? (2) If retroperitoneal, does it arise from the kidney, or is it extrarenal? In establishing these fundamental facts, urologic investigation is a first consideration. After complete urinalysis, a plain film of the abdomen is made with a technic designed to bring out soft tissue masses to best advantage. Following this an intravenous pyelogram is made, and it is our practice to make films at intervals of five, fifteen, thirty and sixty minutes following injection of diodrast If the

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desired information is not obtained by these studies, one must proceed with cystoscopy, ureteral catheterization and retrograde pyelography. Added studies in selected cases include lateral oblique pyelograms or

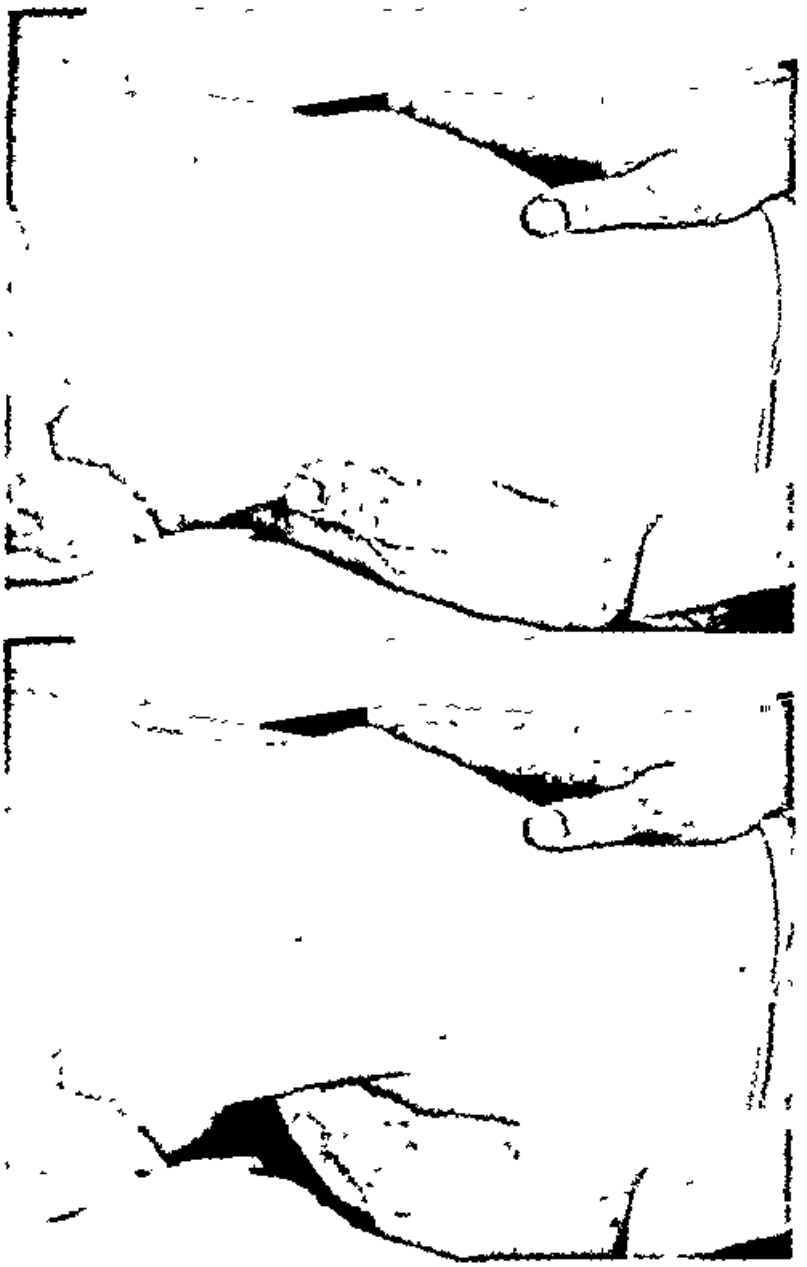

FIG 330.—Technic of ballottement of abdominal masses showing, *upper*, position of hands and *lower*, quick upward thrust of posterior hand, as described in text.

respiration pyelograms, for which the technic and indications will be discussed later

All masses fall into three broad categories: (1) those which are intraperitoneal, (2) those which are retroperitoneal but extrarenal; and (3) masses of renal origin

INTRAPERITONEAL MASSES

In this discussion we are concerned only with those masses which by their location must be differentiated from those arising from the urinary tract. This includes particularly those which occur laterally. On the right side they may arise from the liver, biliary tract, ascending colon, or occasionally from the pancreas or mesentery. On the left side, the spleen is the most common site, although the descending colon and tail of the pancreas must be considered.

Masses within the peritoneal cavity are generally movable, and the absence of ballottement tends to exclude retroperitoneal location. In

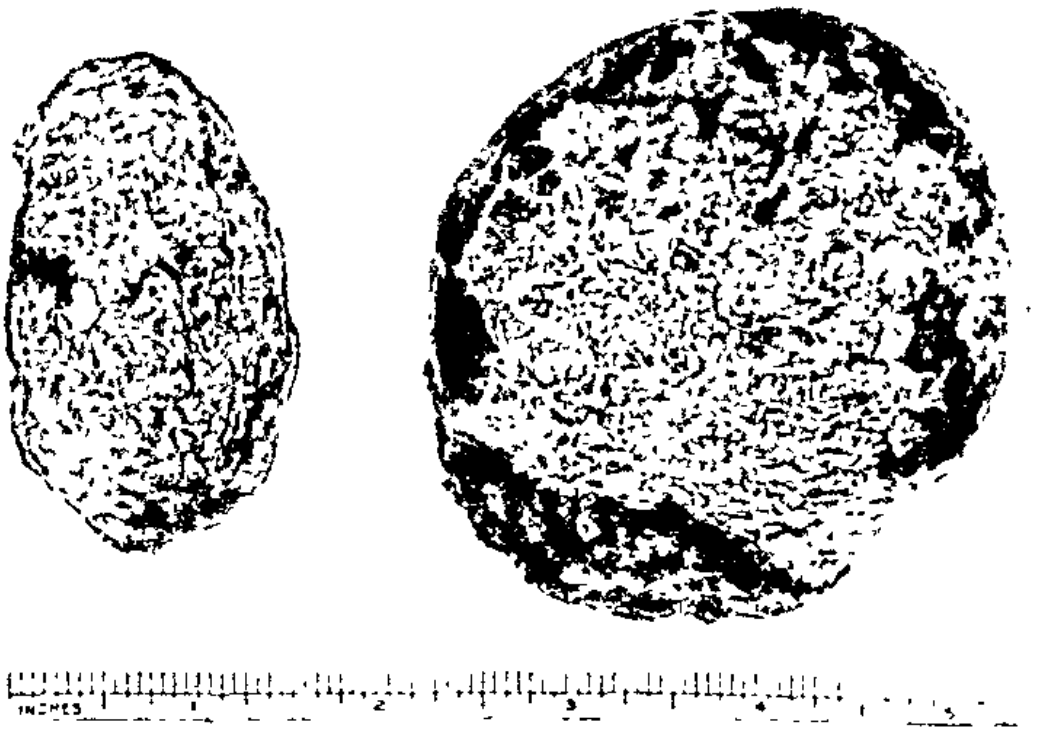

FIG. 331 (Case I).—Gross pathologic specimen of large hemangioma of liver.

most instances urographic study will be negative, and a normal pyelogram immediately excludes the possibility of a retroperitoneal mass.

CASE I.—A woman, 54 years of age, was admitted with the chief complaint of an abdominal mass which had been discovered during the course of an examination for indefinite gastrointestinal symptoms. The mass was in the right side and was smooth, rounded and nontender; it moved freely with respiration and was the size of an indoor baseball Because ballottement was absent, its intra-abdominal location was suspected; a normal pyelogram was finally required to exclude the kidney.

At operation a large hemangioma of the liver was discovered and removed (Fig. 331).

CASE II —A 47 year old woman complained of a tender lump in the upper right side of the abdomen which had first been observed three days previously The detailed history was of little assistance in determining the nature of this mass.

Examination revealed the presence of a firm, slightly tender, irregular mass in the upper right quadrant, it moved freely with respiration, and ballottement was thought to be present Because of this it was thought that the mass arose from the kidney However, pyelograms in the anteroposterior and lateral oblique positions were quite normal Later a cholecystogram and a recheck examination with a second dose of dye did not reveal the gallbladder, and at subsequent laparotomy a large empyema of the gallbladder with an obstructing stone in the cystic duct was removed The gallbladder may attain considerable size and appear in strange locations In one case a mass in the lower right quadrant proved to be the gallbladder

CASE III —A man, 48 years of age, was admitted with the complaint of fatigue and weight loss Symptoms were of about six months' duration but had been more severe during the past two months, during which he had lost 20 pounds and had a moderate fever

There was a hard rounded mass in the right upper quadrant of the abdomen, this moved with respiration and was not tender Although it seemed to lie too far anterior to be a kidney, the kidney could not be excluded Further suspicion was raised by the urinalysis, which demonstrated 4 plus albumin and occasional pus cells

A retrograde pyelogram and an additional oblique film were entirely normal After further study, operation was performed and a large abscess of the liver was drained, following which the patient made a complete recovery This was thought to be an amebic abscess, although parasites were not found in the stools or contents of the abscess

Thus, masses which one strongly suspects to be of renal origin may prove to be associated with disease in the liver The urologist's assistance in directing attention away from the kidney permits the proper selection of abdominal exploration to effect a cure of the disease

The problem also presents itself frequently on the left side of the abdomen In our experience the most common intraperitoneal masses on this side arise from enlargement of the spleen The following case is typical

CASE IV —A 52 year old woman came to the Cleveland Clinic complaining of weight loss and painless enlargement of the upper abdomen, which was first noted one year previously The physical examination did not reveal significant abnormalities except for the presence of a mass in the upper left abdominal quadrant which was firm, irregular, and moved with respiration Absence of ballottement suggested intraperitoneal location, but it was not possible to exclude the kidney A retrograde pyelogram was normal, thereby excluding a retroperitoneal mass

Abdominal exploration was performed, at which time splenomegaly due to Banti's disease was diagnosed

Masses which arise from the descending colon rarely mislead the consultant, for by the time a mass has appeared, symptoms directing attention to the colon are obvious

RETROPERITONEAL EXTRARENAL TUMORS

There is a group of retroperitoneal tumors which are of particular interest. They arise from embryonal cell rests, and the majority are of mesodermal origin, though some show ectodermal elements (neurogenic and teratomatous) Hansmann and Budd[1] believed that these tumors arise from embryonic remnants of the urogenital tract and as evidence cited the diversity of histologic elements and also the fact that similar tumors are frequently found in the adult urogenital organs.

These tumors may be solid or cystic and often grow to considerable size. They occur in the flank, are usually freely movable and demonstrate ballottement. Often they do not produce symptoms and are brought to the attention of the physician because the patient discovers "a lump in the side," or as an incidental discovery during the course of a routine examination They are often well-circumscribed encapsulated tumors showing little tendency to invasion, and only about 10 per cent will be found inoperable By concentric enlargement they may displace adjacent organs but, because of slow growth, do not often disturb function. Large tumors may displace the ureter without obstructing it.

Other retroperitoneal tumors must be considered Among them are those arising from the adrenal glands. While the associated endocrine changes usually direct attention to the true nature of such tumors, we have seen one instance in which a large cortical tumor produced no noteworthy symptoms of cortical hyperactivity. In our experience the finding of palpable tumors of the adrenal gland is rare.

Metastatic retroperitoneal masses are characterized by their irregularity and fixation and the associated cachexia of the patient which usually accompanies their presence Displacement and fixation of the ureter, sometimes with obstruction or actual invasion, completes the picture in advanced cases. I have recently seen a patient in whom anuria resulted from bilateral ureteral obstruction produced by retroperitoneal extension of an ovarian cancer.

Urologic investigation is of particular value in diagnosing retroperitoneal tumors. Their presence is indicated by a soft tissue mass seen on the plain roentgenogram of the abdomen which may exist independently of the renal shadow. The intravenous urogram will establish the presence of undisturbed renal function on the involved side, and renal displace-

ment is one of the most constant findings in retroperitoneal tumors. Lateral or medial displacement is especially significant, and renal rotation may accompany this. Downward and upward displacement indicates tumors above or below the kidney, respectively. Accompanying the renal displacement there may be compression and distortion of the renal pelvis. The intravenous pyelogram does not usually afford sufficiently detailed anatomic delineation of the pelvis for the study of deformities, and for this purpose retrograde pyelography is necessary Furthermore, ureteral visualization is too inconstant with intravenous urography to determine their course, which can be reliably accomplished only by ureteral catheterization or retrograde ureterogram

Having performed cystoscopy and ureteral catheterization and obtained a retrograde pyelogram, the films are inspected to determine ureteral displacement and for more detailed examination of the renal pelvis. One must differentiate distortion due to external pressure from true deformity produced by intrarenal lesions The most significant differences may be tabulated as follows.

PYELOGRAPHIC DIFFERENTIATION

Extrarenal Mass	Intrarenal Origin
Pelvis displaced laterally or medially	Rarely
Rotation of kidney on vertical or transverse axis	Rarely
Calices normal in number	Some calices missing due to invasion of internal compression
Calices normal in relation to each other	Calices separated or otherwise out of normal relationship
Margins of pelvis and calices regular and smooth	Margins irregular and deformed due to invasion
Renal shadow normal	Renal shadow irregular and mass usually visible

In many instances the lateral pyelogram will be of great assistance. This is best made in an oblique position, the patient being at about a 60 degree angle to the table, with the involved side down. In this way the renal pelvis is anterior to the vertebral column, thus permitting better visualization.

Many of these points are illustrated by the following cases:

CASE V.—A woman, 47 years of age, entered the Cleveland Clinic stating that she had high blood pressure. Symptoms consisted chiefly of palpitation and pounding of the heart, mild dyspnea on exertion, and weakness Examination revealed the blood pressure to be 220 systolic, 105 diastolic. There was some cardiac enlargment and a soft apical systolic murmur A mass was discovered in the abdomen The original examiner described this as an enlargement of the liver, 4 fingerbreadths below the costal margin on the right and down to the umbilicus on the left A cardiac consultant interpreted this as a bilateral mass and suggested polycystic kidneys as the basis of her trouble A third consultant noted a cystic mass in the left flank These observations are recorded to indicate the varied interpretations so characteristic in such cases.

The plain film of the abdomen revealed a huge soft tissue mass filling the upper left quadrant of the abdomen. An intravenous pyelogram revealed no dye in the left kidney region There was a bizarre shadow on the right side which could not be clearly interpreted, thus necessitating retrograde pyelography. This revealed a normal right renal pelvis The left ureter was found to cross the midline and even extended beyond the right ureter. When the pelvis was filled with contrast medium, a hydronephrotic left kidney pelvis was revealed, far displaced so that it overlay the right kidney pelvis (Fig. 332). At operation a large well-encapsulated cystic fibroma, in no way connected with the kidney, was removed. The left kidney returned to its normal position following operation (Fig 333).

CASE VI.—A 17 year old boy had consulted his family physician because of mild nausea, loss of appetite, and fatigue. Examination revealed a mass in the right abdomen, thought to be a kidney, and the patient was referred for further study

The mass was hard, moved with respiration, and was thought to be ballottable A plain film revealed a large soft tissue mass containing irregular calcific deposits. An intravenous urogram revealed a normal left kidney. The right renal pelvis was compressed and displaced upward, and the tumor mass appeared to be attached to the lower pole of the kidney (Fig 334). It was thought to be a case of Wilms' tumor of the kidney, and operation was advised. At operation a solid well-encapsulated retroperitoneal tumor was removed which was in no way attached to the kidney (Fig. 335). The pathologic diagnosis was fibroma, probably neurogenic in origin, with calcification and recent hemorrhage.

CASE VII.—A man, 48 years of age, about one week prior to examination was awakened with a twinge of pain in the right side and discovered that there was a lump in his side. He consulted his local physician who referred him to the Cleveland Clinic for further study. Examination revealed a hard, irregular mass in the right upper abdomen and flank which moved with respiration and was at first thought to be the liver. A plain roentgenogram of the abdomen revealed a large soft tissue shadow in the right upper abdomen A cholecystogram and gas-

Fig 332

Fig 333

Fig 332 (Case V).—Bilateral pyelogram. Large soft tissue mass filling left side of abdomen clearly visible. The bizarre pyelogram is produced by a hydronephrotic renal pelvis of left kidney overlying normal right kidney pelvis.

Fig 333 (Case V).—postoperative intravenous pyelogram, showing return of left kidney to normal position following removal of a large retroperitoneal cystic fibroma.

Fig 334

Fig 335

Fig 334 (Case VI).—Intravenous pyelogram showing normal renal pelvis on the left and a large tumor mass with calcification on the right. Displaced compressed renal pelvis is at upper end of this mass.

Fig. 335 (Case VI).—Gross specimen showing well-encapsulated retroperitoneal fibroma.

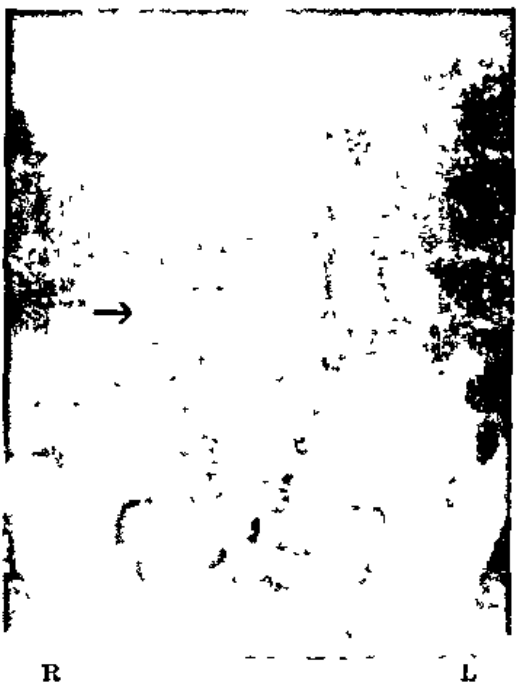

FIG. 336 (Case VII) —Intravenous pyelogram showing large tumor mass in right upper quadrant of abdomen displacing kidney pelvis downward and producing vertical rotation. Arrow points to displaced renal pelvis

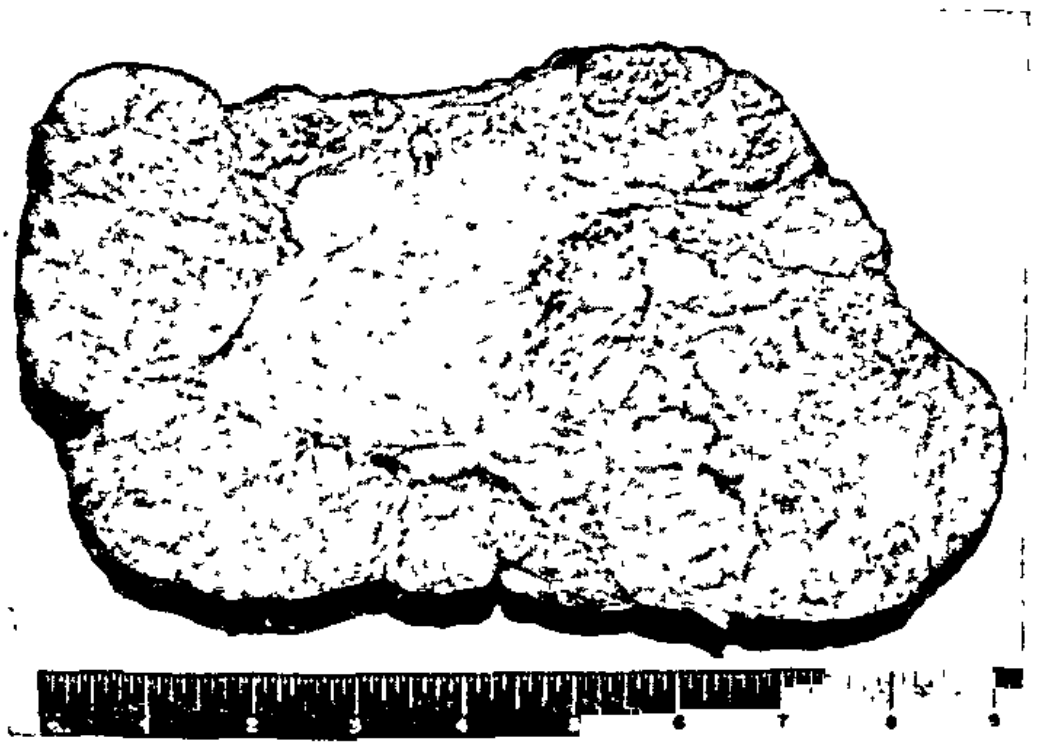

FIG 337 (Case VII) —Sectioned gross specimen of tumor Pathologic diagnosis was adrenal cortical carcinoma

trointestinal roentgenologic studies were normal. An intravenous urogram, however, revealed pronounced downward displacement of the kidney with compression and distortion of the renal pelvis but no true deformity (Fig 336). Having

thus established the retroperitoneal location, operation was carried out through an oblique kidney incision, and a large, irregular, well-encapsulated tumor having no renal attachment was removed Examination of the mass showed it to be a primary adrenal cortical carcinoma (Fig. 337).

Case VIII.—A 69 year old man complained of severe weakness, anemia, inability to eat and weight loss Although he had not been completely well for nine or ten months, most of the symptoms were of about only three weeks' duration, during which time they had increased rapidly.

Fig 338.

Fig 339.

Fig. 338 (Case VIII)—Bilateral retrograde pyelogram showing extreme ureteral displacement and lateral displacement of left renal pelvis with hydronephrosis of right kidney. Diagnosis was extensive metastatic retroperitoneal carcinoma

Fig. 339—Respiration pyelogram showing fixation of left kidney with normal renal mobility on the right side This patient had a perinephric abscess on the left

The significant finding on physical examination was the presence of a dis-

[illegible]

of the right ureter and hydronephrosis (Fig. 338). An exploratory laparotomy was performed, at which time it was determined that the patient had a large retroperitoneal mass. Biopsy showed metastatic carcinoma.

The patient became progressively worse and died about two weeks later. An autopsy revealed extensive retroperitoneal metastatic carcinoma, apparently primary in the gallbladder; hydronephrosis of the right kidney was found to be due to obstruction of the right ureter by compression.

Many other examples could be cited, but all serve to exemplify the value of urologic study not only in localizing these tumors but also in helping to estimate their operability and to determine the surgical approach.

An intermediate group of cases includes perinephric infections and abscesses. The mass is invariably fixed and not ballottable, and usually severe tenderness is manifested. There may be bulging of the costovertebral space, and an indicative physical finding is pain on bending toward the affected side in contrast to bending in the opposite direction.

The plain film of the abdomen often shows obliteration of the psoas shadow and curvature of the spine, the concavity of which is toward the affected side. A useful aid is a respiration pyelogram. It is most satisfactorily demonstrated by a bilateral retrograde pyelogram; with the pelves filled, a double exposure is made on the same film, one with the patient in deep inspiration and the second in deep expiration, x-ray exposure for each being about 75 per cent of that usually employed for a single exposure. The presence of a fixed kidney on the involved side with normal renal mobility of the opposite kidney argues strongly in favor of perinephric infection (Fig. 339).

MASSES OF RENAL ORIGIN

The majority of palpable masses in the sides of the abdomen arise from the kidney and may be the result of any one of several pathologic processes. Obstructive lesions at the ureteropelvic junction can produce hydronephrotic dilatation of palpable size. Pyonephrosis with or without calculi often results in a palpable mass, as may cortical abscess of the kidney. Tumors and cysts are frequently palpable, and bilateral palpable masses may be diagnosed as polycystic kidneys with statistical probability. A wide variety of renal lesions must be considered.

Here, obviously, urologic investigation clarifies the diagnosis. These patients do not always come to the urologist and may seek medical attention for symptoms unrelated to the urinary tract. Thus gastrointestinal symptoms may result from obstructive and inflammatory lesions of the kidney, and unexplained fever or anemia may be due to chronic renal infection or malignant disease in the kidney. A case will be cited later in which a palpable mass in the upper right abdomen was thought to be cirrhosis of the liver but proved to be hemorrhagic cystadenoma of the kidney. Frequently what is interpreted as splenomegaly proves to be a

renal mass Thus, no mass can be identified certainly without complete urologic investigation, which must include adequate roentgenologic and pyelographic study.

Case IX —A 40 year old man was admitted with the complaint of pain in the right side and back. Intermittent attacks had begun about three years previously The symptoms increased in the four months preceding our examination, and the patient had observed some fullness in the right flank

Examination revealed moderate hypertension, the blood pressure being 170 systolic, 114 diastolic The other significant finding was the presence of a large firm mass in the right upper quadrant, this was so large that it actually produced some flaring of the ribs and appeared to move with respiration It extended at least 4 fingerbreadths below the costal margin The original impression was that the mass was an enlargement of the liver, probably due to cirrhosis The cholecystogram was normal Urogram revealed no function from the right kidney with a large soft tissue mass in this region A retrograde pyelogram showed a large hydronephrosis, with elevation and deformity of the renal pelvis due to a lesion at the lower pole of the kidney The upper right ureter was displaced medially Aspiration yielded 1200 cc of bloody fluid At subsequent nephrectomy, a huge cystic adenoma of the right kidney was removed which contained hemorrhagic fluid in the cyst

Case X —A 62 year old woman was admitted for general examination There were no specific symptoms directing attention to any particular system or lesion

On examination she was found to have hypertension, the blood pressure being 210 systolic, 100 diastolic The other significant finding was the presence of a large mass in the right flank, this was irregular, freely movable and ballottable, and renal tumor was suspected An intravenous urogram revealed a large soft tissue mass in the right flank with a questionable filling defect of the kidney pelvis A retrograde pyelogram revealed a duplex kidney pelvis with partial

of the kidney was removed

Case XI —A baby, 19 months of age, had a mass in the right side which had been observed only one week previously by his parents

Examination revealed a rather pale, anemic infant The outstanding positive finding was the presence of a large, hard, rather smooth mass occupying the entire right side of the abdomen A diagnosis of probable Wilms' tumor was made After preliminary x-ray therapy a nephrectomy was carried out and a large tumor of the kidney was removed This proved to be a Wilms tumor with mesenchymal elements predominating

Case XII —A 5 year old boy had a mass in the left flank, thought to be a Wilms' tumor This had produced virtually no symptoms and had been accidentally observed by the mother

On examination there was a mass the size of a large grapefruit occupying most of the left flank However, on palpation it appeared to be cystic and was ballottable. An intravenous urogram showed the right kidney to be normal but no function from the left. There was a soft tissue mass in the region of the left kidney Because of the cystic character of the mass a large hydronephrosis was suspected This diagnosis was confirmed when about ten days later the patient returned with no mass palpable, indicating that drainage had been established At operation a large hydronephrotic sac with ureteropelvic obstruction due to an aberrant artery was removed.

CASE XIII.—A man, 72 years of age, six years previously had had a right colectomy performed at the Cleveland Clinic Hospital for adenocarcinoma of the

FIG 340 (Case X) —Retrograde pyelogram showing displacement of ureters and deformity of lower pelvis of duplex kidney At operation this proved to be hypernephroma of the kidney.

ascending colon He had remained well until about five years later, when he began

original tumor or an independent tumor of the kidney. Intravenous urogram revealed a questionable filling defect of the right kidney pelvis. Retrograde pyelogram revealed a definite deformity of the right renal pelvis (Fig. 341). A diagnosis of kidney tumor was made, probably hypernephroma.

The patient did not consent to immediate operation. He returned later in a

seriously weakened condition, which did not permit surgical exploration, and died two weeks later. At autopsy a hypernephroma of the kidney with extensive distant metastases was found (Fig. 342).

This case well illustrated the importance of examining all masses and not concluding that a mass represents recurrence of a previous tumor.

Case XIV.—A 41 year old woman came to the Cleveland Clinic complaining of a lump in the right side. This had been observed five or six years previously, and she believed it had shown progressive enlargement. There had been no pain or other symptoms.

Fig 341

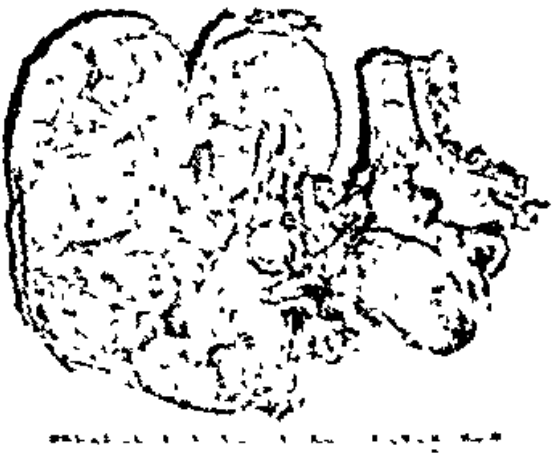

Fig 342

Fig 341 (Case XIII).—Retrograde right pyelogram showing deformity of kidney pelvis due to renal tumor.

Fig 342 (Case XIII).—Gross autopsy specimen showing large hypernephroma of kidney with large tumor thrombus.

On examination there was a large, irregular mass in the right flank which moved freely with respiration and was definitely ballottable. Intravenous urogram revealed a questionable deformity of the right kidney pelvis. Retrograde pyelography revealed a rather unusual deformity of the right kidney pelvis in that the calices were greatly elongated, and lateral pyelogram revealed curvilinear deformity of the renal pelvis (Fig. 343).

At operation a large multilocular cyst of the kidney arising from the anterior surface was excised.

Case XV.—A 35 year old woman complained of frequency and burning of urination together with severe weakness and weight loss. On examination she was found to be pale, anemic and emaciated, weighing only 87 pounds. There was a large, hard, fixed mass in the right flank; this was exquisitely tender. Retrograde pyelogram showed an extensive deformity of the renal pelvis characteristic

Fig 343.

Fig 344

FIG. 343 (Case XIV) —Bilateral retrograde pyelogram Left pyelogram was normal. Unusual deformity on the right side produced by multilocular cyst of kidney

FIG. 344 (Case XV) —Right pyelogram showing extensive deformity and fragmentation of the renal pelvis due to pyonephrosis.

FIG 345 (Case XVI).—Retrograde left pyelogram Deformity of lower calyx, large, smooth, circular mass due to solitary cyst of the lower pole of kidney.

of pyonephrosis (Fig. 344). At operation a large pyonephrotic kidney was removed in which the primary disease was renal tuberculosis with severe secondary pyogenic infection.

CASE XVI —A woman, 44 years of age, came to the Cleveland Clinic because of painful feet and other varied symptoms, none relating to the kidney or gastrointestinal tract At the time of routine physical examination a mass was palpated in the left kidney area; this was freely movable, ballottable and nontender A plain film of the abdomen revealed a smoothly rounded soft tissue shadow in the lower pole of the left kidney Retrograde pyelogram revealed a typical deformity of the lower calyx, which, because of its smoothly rounded contour, led to the diagnosis of solitary cyst of the lower pole of the kidney (Fig 345)

These cases exemplify the common pathologic lesions of the kidney which may produce palpable masses in the abdomen. Their identification is obviously important for the selection of proper surgical approach Furthermore, if one contemplates a nephrectomy the functional capacity and normality of the opposite kidney must be established It is only by means of careful urologic study that these facts can be ascertained

SUMMARY

Attention has been called to the diagnostic difficulty which often attends the discovery of a palpable mass in the abdomen. One must disparage the tendency to consider "abdominal mass" as an adequate diagnosis for which to recommend surgical intervention. The diagnosis must be drawn much finer in order to justify operation or to plan the surgical approach, once operation is decided upon. In arriving at a correct diagnosis complete urologic investigation is of great value and should be carried out in all cases

Several clinical aphorisms emerge from a study of these cases.

1. A normal pyelogram immediately excludes a retroperitoneal mass
2. Ureteral displacement indicates a retroperitoneal mass
3 Renal displacement denotes retroperitoneal tumor.
4. Distortion of the renal pelvis may be produced by extrarenal masses
5. True deformity of the renal pelvis always indicates an intrinsic kidney lesion

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TRANSPLANTATION OF THE URETERS INTO THE RECTOSIGMOID AND CYSTECTOMY

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OPERATIVE procedures conducted within the abdominal cavity involve more than one system in an increasing number of instances. Transplantation of the ureters so that urine empties into the bowel is one such example This operation now is indicated in a number of different disorders.

Since 1852 when Simon[1] described an operative technic for implanting the ureters into the rectosigmoid, numerous new procedures or modifications of previous technics have been described for diversion of the urinary stream into the bowel.

Prior to the introduction of intravenous urography it was believed that ureteral obstruction invariably followed implantation of the ureters into the rectosigmoid. This was thought to produce stasis and to be conducive to superimposed renal infection, eventually leading to death from renal failure and sepsis That such erroneous deductions were unwarranted is now evident from intravenous urograms made several years after operation. If the technical details of the operation have been carefully followed, the ureters and kidneys remain in a normal or fairly normal condition over a period of years, as shown on the urograms.

INDICATIONS

Exstrophy of the Bladder.—At the present time the procedure of choice for exstrophy of the bladder is transplantation of the ureters into the rectosigmoid and cystectomy. Unless children born with this condition are given the benefit of surgical intervention, 50 per cent of them die before the age of 10 years, and 66.6 per cent of them die before the age of 20 years. There are no accurate statistics citing the incidence of death during the first few years of life (Fig. 346).

The operation should be performed during the first year for the following reasons: (1) Infants tolerate surgical procedures well This is evident from the results obtained from other operations, such as those for strangulated hernia, hypertrophic pyloric stenosis and intussusception. (2) The operative mortality and morbidity are low. (3) As years elapse recurring attacks of pyelonephritis result in irreparable kidney damage, sepsis, and frequently death when operation is delayed. (4) It is probable that the organisms in the bowel of the infant are less virulent than in older children. (5) Early operation permits normal development from

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transitional epithelium. The epithelial cells were irregularly arranged, and a few had abnormal nuclei of large size and irregular shape Mitoses were present in moderate number, a few of which were slightly atypical. The basement membrane in most regions was intact, but at a few sites it could not be identified. In such portions inflammation was marked There was no clearly demonstrable epithelial invasion.

FIG 347.—Intravenous urogram one and one-half years after transplantation of ureters into rectosigmoid and cystectomy for carcinoma of bladder

Sections of the right ureter showed the wall to be fibrous and infiltrated with many lymphocytes and large mononuclear cells Most of the lining epithelium was absent and, where present, was of the transitional type. Near one edge of the section the epithelium was unusually thick and atypical. Some of the cells were large and many had deeply chromatic nuclei These atypical epithelial cells were similar to those in the tumor of the urinary bladder.

Sections of the left ureter showed the lumen to be patent and the lining epithelium to be thin. In the mucosa-submucosa there were many lymphocytes, large mononuclear cells and a few neutrophilic leukocytes.

Examination of a section of the prostate showed the fibromuscular stroma to be compact and of the usual type. Glands were abundant and fairly uniform in size. They were lined with regular columnar epithelium. No atypical cells were seen

Epispadias.—*Epispadias can usually be corrected by plastic operations.* However, the defect is occasionally so extensive that incontinence persists even after continuity of the urethra has been re-established. In these rare cases transplantation of the ureters into the bowel may be advisable. We have performed the radical operation on only two children, multiple operations having been previously performed elsewhere in each case

Tuberculous Cystitis.—Occasionally in unilateral renal tuberculosis intolerable bladder symptoms continue after nephrectomy has been performed. The bladder capacity is reduced, and the ureter on the normal side shows dilatation with a coexisting early hydronephrosis. If conservative treatment does not afford relief and the degree of hydronephrosis is progressing, the urine from the remaining kidney may be diverted into the bowel by a uretero-intestinal anastomosis. The bladder is not removed following this operation.

Interstitial Cystitis.—The symptoms of interstitial cystitis can usually be alleviated by conservative treatment. On rare occasions the patient is unable to retain any urine in the bladder, the wall is thickened and fibrosed and overdistention is impossible. If conservative treatment is of no avail transplantation of the ureters into the rectosigmoid without cystectomy may be justified.

Incontinence Following Transurethral Resection.—Incontinence may follow transurethral resection for hypertrophy of the prostate, contracted bladder neck, or bars if the external sphincter is injured. The patient should not be forced to wear a receptacle if the incontinence is permanent, as complete relief can be afforded by transplantation of the ureters into the bowel. Fortunately such an operation is not often necessary The patient gladly prefers operation to the disadvantages of wearing a receptacle which has an unavoidable odor and is difficult to manage.

Vesicovaginal Fistula.—In most cases vesicovaginal fistula can be repaired by plastic operations. However, the defect may so extensively involve the bladder, sphincter and urethra that even when the defect is closed the patient remains incontinent. In such cases transplantation of the ureters into the rectosigmoid may result in complete relief.

OPERATION

In infants the operation for transplantation of the ureters and cystectomy is performed in two stages The right ureter is first implanted into the bowel, and ten days later the left ureter is transplanted into the rectosigmoid and the exstrophic bladder is removed The operation is tech-

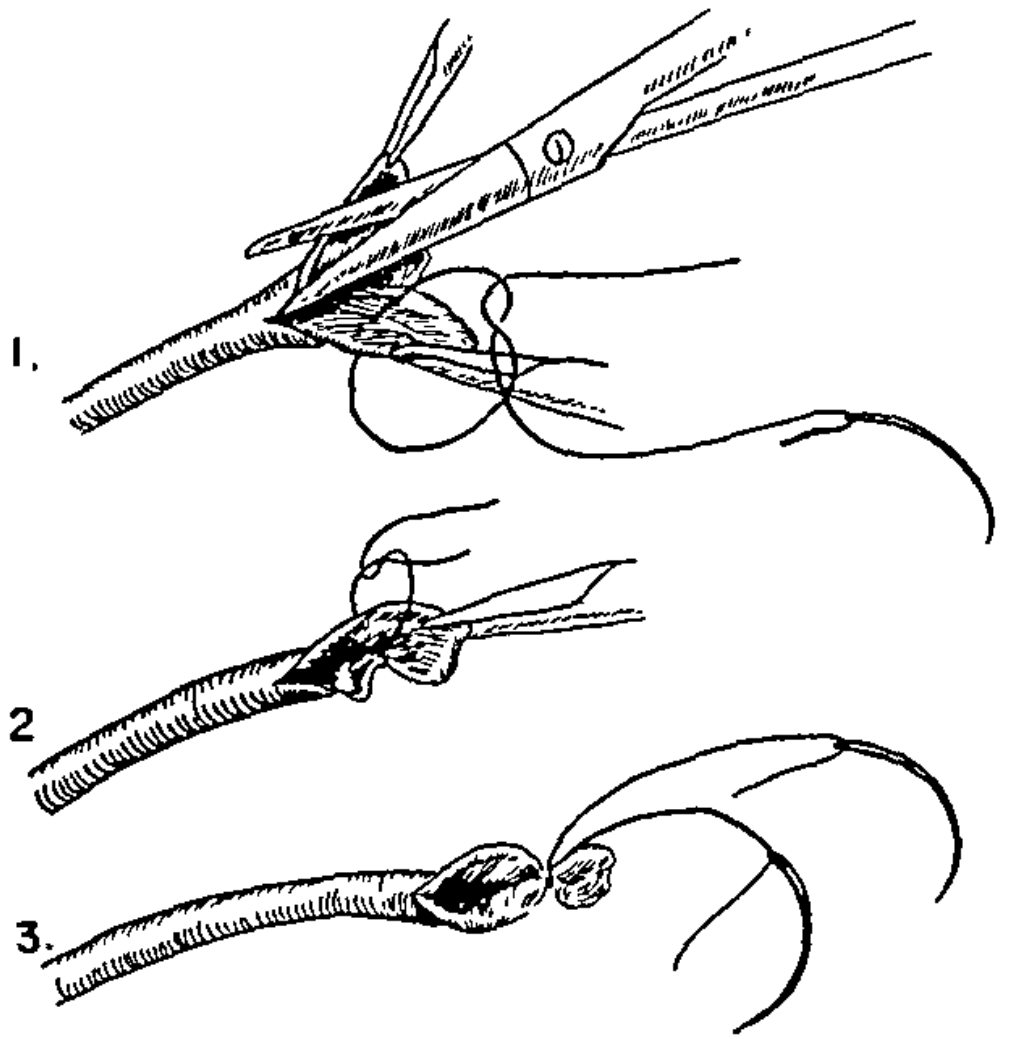


FIG. 318.—Preparation of ureter to be transplanted into rectosigmoid *1*, Division of free end of ureter to establish larger opening, *2*, *3*, suture passed through free end of ureter which is to be transplanted into bowel

nically more difficult in infants. As it is a plastic procedure, the technical details must be carefully followed.

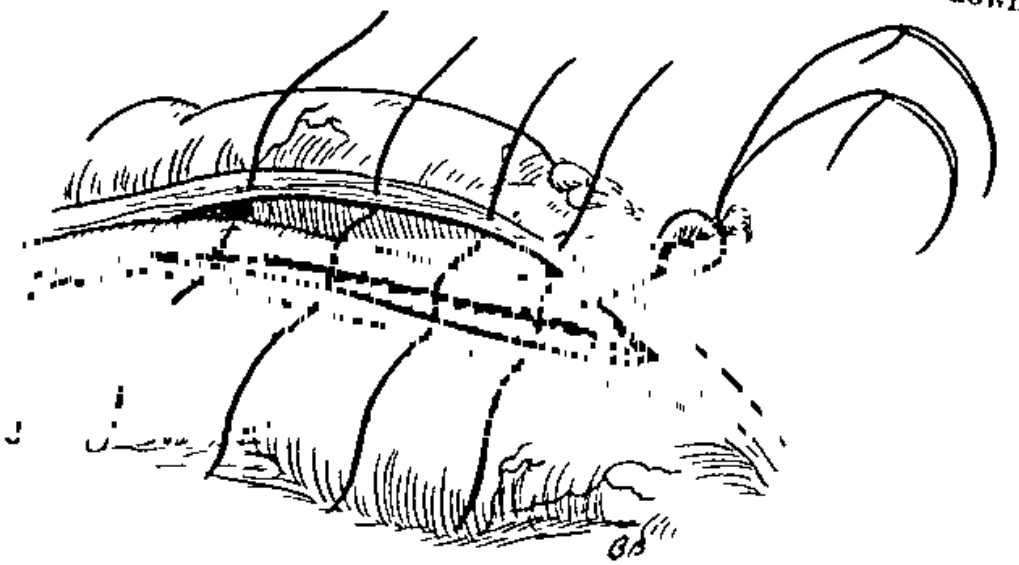
In adults the general condition of the patient, the presence or absence of renal infection, and the caliber of the ureters influence the decision as to whether both ureters should be transplanted simultaneously or whether unilateral transplantation of the ureters is preferable. Generally in adults I prefer to transplant the right ureter into the rectosigmoid in one stage, transplanting the left ureter and performing the cystectomy seven

to ten days later. In younger patients with carcinoma of the bladder the ureters may be transplanted simultaneously and the bladder removed at one operation. The patient is anesthetized with ether if a child, spinal anesthesia if an adult, and is placed in moderate Trendelenburg position. A low right rectus incision is made. After the peritoneum has been incised the intestines are displaced upward and held away from the operative field by moist tapes. The right ureter is isolated, and a longitudinal

FIG 349.—*1*, Trough in bowel to be occupied by ureter; *2*, ureter placed in trough, distal suture in place. (*Continued on next page.*)

incision is made in the posterior peritoneum overlying the ureter. The ureter is dissected from its bed down to the bladder, care being taken that no periureteral tissue or blood vessels are stripped from the ureter. The ureter is then divided close to the bladder, and the stump attached to the bladder is ligated. When the ureter is freed for approximately 2 inches it is lifted upward, and the posterior peritoneum is closed with 000 catgut. The site for transplantation of the right ureter is then selected in the rectosigmoid at a point in which kinking and angulation of the ureter

will not occur A longitudinal incision 1½ to 2 inches in length is then made throughout the serosal and muscularis coats of the bowel down to



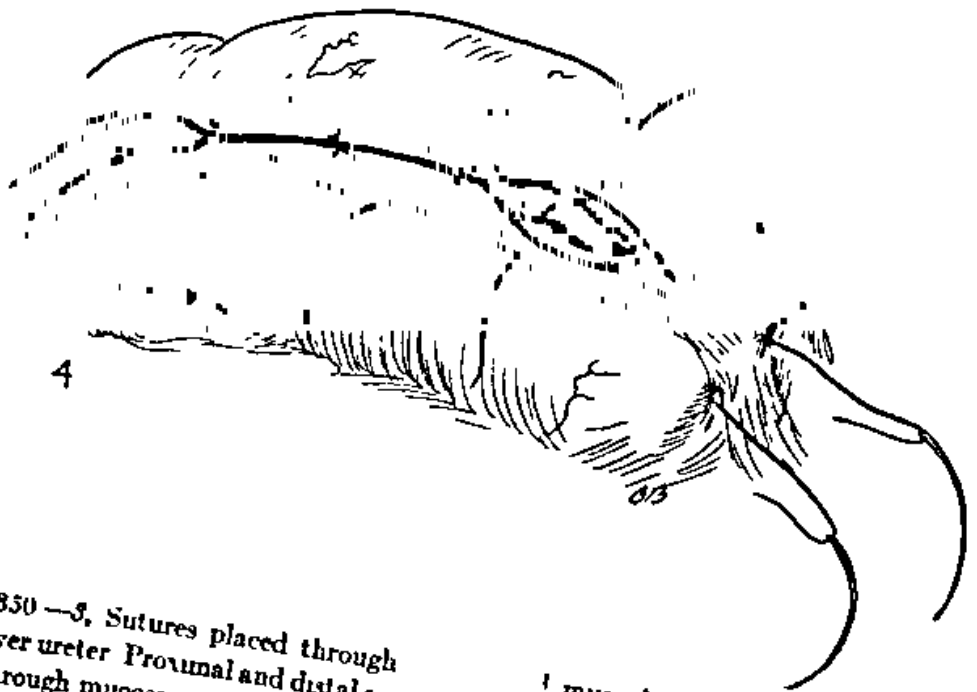


FIG 350.—3, Sutures placed through trough over ureter Proximal and distal s wound through mucosa into lumen of rectosigmoid anchoring stitch with two x

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The free end of the ureter is then split for a short distance with a pair of scissors. A special 00 catgut suture with a fine round needle on each end is passed through the cut end of the ureter and tied (Fig. 348). The bowel is replaced in its normal position, and the ureter is placed in the trough in the bowel (Fig. 349). Tension on the ureter, kinking, and angulation must be avoided.

The ureter is then anchored in the trough by passing the sutures through the serosal and muscularis layers of the bowel which are reapproximated over the ureter (Fig. 350) Two or three sutures also pass through some adventitial tissue of the ureter. Care must be taken to avoid passing the suture into the lumen of the ureter. Triple 0 catgut is used. After inspection of the operative field to ascertain whether or not the anastomosis is satisfactory, a small incision is made through the mucosa of the bowel into the lumen with a spear-point knife. One needle and suture from the free end of the ureter is passed into the lumen and out of the wall of the bowel $\frac{1}{2}$ to $\frac{3}{4}$ inch below the point of entrance. The other needle and suture is handled in a similar manner. Tension is made on the sutures, drawing the free end of the ureter well into the lumen of the bowel. The sutures are then tied, and the stump of the ureter is held in place in the bowel to prevent retraction. The serosal and muscularis layers of the bowel are then closed over the small opening in the mucosa. A suture including only the serosal layer of bowel is then placed over the points where the needles emerged from the lumen of the rectosigmoid.

Finally the bowel is immobilized at the operative site by being anchored to the posterior peritoneum with two or three interrupted sutures. The abdomen is closed without drainage.

When both ureters are transplanted simultaneously, a low median incison is made. All other details of this procedure are similar to those of the two stage operation.

PREOPERATIVE AND POSTOPERATIVE CARE

No stage of the operation is more important than the initial preparation of the patient.

First and second days

1. Preoperative soft nonresidue diet.
2. Epsom salts, 4 ounces in 8 ounces of water, $\frac{1}{4}$ ounce every fifteen minutes for eight doses each morning.
3. Saline enema each night.
4. Vitamin capsules, 2 a day.
5. Blood urea and hemoglobin determinations

Third and fourth days

1. Preoperative liquid nonresidue diet
2. Epsom salts, vitamins, and enemas continued

3. Streptomycin 0.5 gm. in one-half glass of water twice daily by mouth.
4. Intravenous fluids if needed to stabilize acid-base balance

Fifth preoperative day:

1. Nothing by mouth except 5 per cent glucose water and streptomycin
2. Blood urea, carbon dioxide, chlorides and hemoglobin determinations

Preoperative Orders

1. Saline enemas until clear
2. Pentobarbital 1½ gram at bedtime
3. Pentobarbital 1½ gram two hours before operation
4. Morphine sulfate ⅙ gram and atropine sulfate $\frac{1}{150}$ gram one hour before operation
5. No. 24 catheter inserted into rectum one hour before operation
6. Tincture of opium, 10 drops at 6 P.M. and at 10 P.M. the night before operation and four hours before operation. Dosage of medication varies with the age of the patient

Postoperative Orders

1. Nothing by mouth except streptomycin, 0.5 gm. in 1 ounce of water, morning and night
2. Lips moistened with mineral oil.
3. Blood pressure reading every fifteen minutes until stabilized
4. Patient flat in bed for six hours, then 25 degree elevation.
5. 2000 cc. of 5 per cent glucose in water and 1000 cc. 5 per cent glucose in saline administered intravenously
6. Rectal output charted
7. Tincture of opium, 10 drops four times a day

First postoperative day

1. Blood urea, carbon dioxide, chlorides, and hemoglobin determinations
2. Intravenous fluids and blood transfusions as indicated
3. Nothing by mouth except medication

Second postoperative day

1. Tincture of opium discontinued
2. Intravenous fluids continued.
3. Lips moistened with mineral oil
4. Seventy-five degree back rest
5. Nothing by mouth except medication

Third postoperative day:

1. Water by mouth, 1 ounce every hour.
2. Intravenous fluids continued.

Fourth to eighth postoperative days:

1. Liquid nonresidue diet.
2. Oral streptomycin discontinued

3. Vitamin capsules, 2 a day.
4. Water by mouth as desired.
5. Intravenous fluids and transfusions as indicated.
6. Blood chemistry studies every other day.

Ninth to twelfth postoperative days:

1. Food as desired.
2. Rectal catheter removed.
3. Patient allowed out of bed.
4. Blood urea and carbon dioxide determinations as indicated.

CONCLUSIONS

Adequate preoperative preparation, postoperative care, and refinements in surgical technic have reduced the mortality from this procedure to a point where there should be no hesitancy in recommending the operation in selected cases

The patients are comfortable, have complete control of the urine and may lead a normal life.

Dilatation of the ureters, hydronephrosis and renal sepsis may be avoided by careful attention to the technical details of the operation.

Radical operation is recommended for those cases of carcinoma of the bladder in which conservative treatment carries a high morbidity and little prospect of cure.

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THE COMPLICATIONS OF MECKEL'S DIVERTICULUM IN INFANTS AND CHILDREN

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MECKEL in 1815 described a diverticulum that occurred in the terminal 30 inches of the ileum. There are, no doubt, many people who go through life having a Meckel's diverticulum but never having symptoms from it. Its importance as a surgical lesion is due to the fact that it may give rise to very serious complications which necessitate early surgical intervention. Umphrey,[1] in reviewing the records of 3460 intra-abdominal operations during a five year period, reported Meckel's diverticulum as occurring only nine times. He concluded that many more occurred, but had been missed during these intra-abdominal operations, since it has been estimated by various workers that it occurs in about 2 per cent of all individuals who come to postmortem examination.[2] Because of the serious pathological complications that occur in, or as a result of the presence of a Meckel's diverticulum, it is necessary that the diagnosis and surgical intervention be not delayed.

The vitelline duct, which communicates between the yolk sac and midgut of the embryo, usually is obliterated at birth. Presence of any part of this structure is known as Meckel's diverticulum, but most frequently the intestinal portion of the duct is patent. Connection between the umbilicus and the gut may survive, however, as a fibrous band or intestinal fistula, or the umbilical portion of duct may not close.[3]

The important complications of Meckel's diverticulum are (1) umbilical discharge or cystic tumor, (2) inflammation and perforation, (3) acute hemorrhage, (4) intussusception and (5) intestinal obstruction.

UMBILICAL DISCHARGE

In cases where the Meckel's diverticulum has not become detached from the umbilicus, its presence may be made known by the fact that there is periodic discharge of yellow or yellowish-brown fluid from the

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umbilicus. The reason for the discharge of fluid from the umbilicus lies in the fact that the Meckel's diverticulum is lined with a mucous membrane which is still patent and unless it can empty adequately into the intestinal tract the discharge will either form a cystic tumor at the umbilicus or may be evident by the formation of an umbilical fistula, the opening of the fistula may scar over only to break through when the pressure gets great enough, causing an intermittent discharge. The history as usually given is that the cyst or the umbilical discharge has been evident since birth. Such a history should lead one to suspect the presence of a Meckel's diverticulum The following two cases are illustrative of this condition and illustrate the method of management.

CASE I.—A male child, 12 months of age, was admitted to the hospital with a yellow discharge from the umbilicus since birth Provisional diagnosis of patent vitelline duct was made Laparotomy was performed, disclosing Meckel's diverticulum passing from the umbilicus to the ileum with multiple developmental chylous cysts A diverticulectomy and excision of the umbilicus was performed with an excellent recovery.

CASE II.—This patient was a female child 24 months of age On admission to the hospital a cherry-red mass, which had been present since birth, was seen protruding from the umbilicus There had been periodic discharge of yellow and hemorrhagic colored fluid from the umbilicus since birth A preoperative diagnosis of persistent urachus was made and at laparotomy a Meckel's diverticulum which was attached to the umbilicus (Fig 351) was removed, with an excellent recovery

INFLAMMATION AND PERFORATION

Inflammation with or without perforation of a Meckel's diverticulum is apparently more common in children than in adults. Inflammation that occurs in Meckel's diverticulum is not difficult to explain, since the diverticulum is a blind saceulation much like the appendix with a great deal more variation in size, shape and cellular structure. In cases where the diverticulum has a wide base, obstruction is not so likely to occur. However, when the mouth of the diverticulum is small or constricted it predisposes to inflammation. Inflammation in a Meckel's diverticulum is usually characterized clinically by periumbilical pain, nausea and vomiting, and local tenderness in the lower abdomen, usually at the level of the umbilicus or to the right, with an accompanying leukocytosis and polymorphonucleocytosis. The symptoms are so similar to acute appendicitis associated with tension on the mesentery that the diagnosis of appendicitis is usually made prior to operation. Frequently there is a history of repeated attacks of the above syndrome of mild severity and the symptoms have subsided As a rule, no abnormality is noted when

gastrointestinal studies are made, and in our experience x-ray studies, even with the hourly films of the small bowel, are worthless in the diagnosis of a Meckel's diverticulum. For this reason we have long since abandoned this study, even in the suspected cases. The cases in this

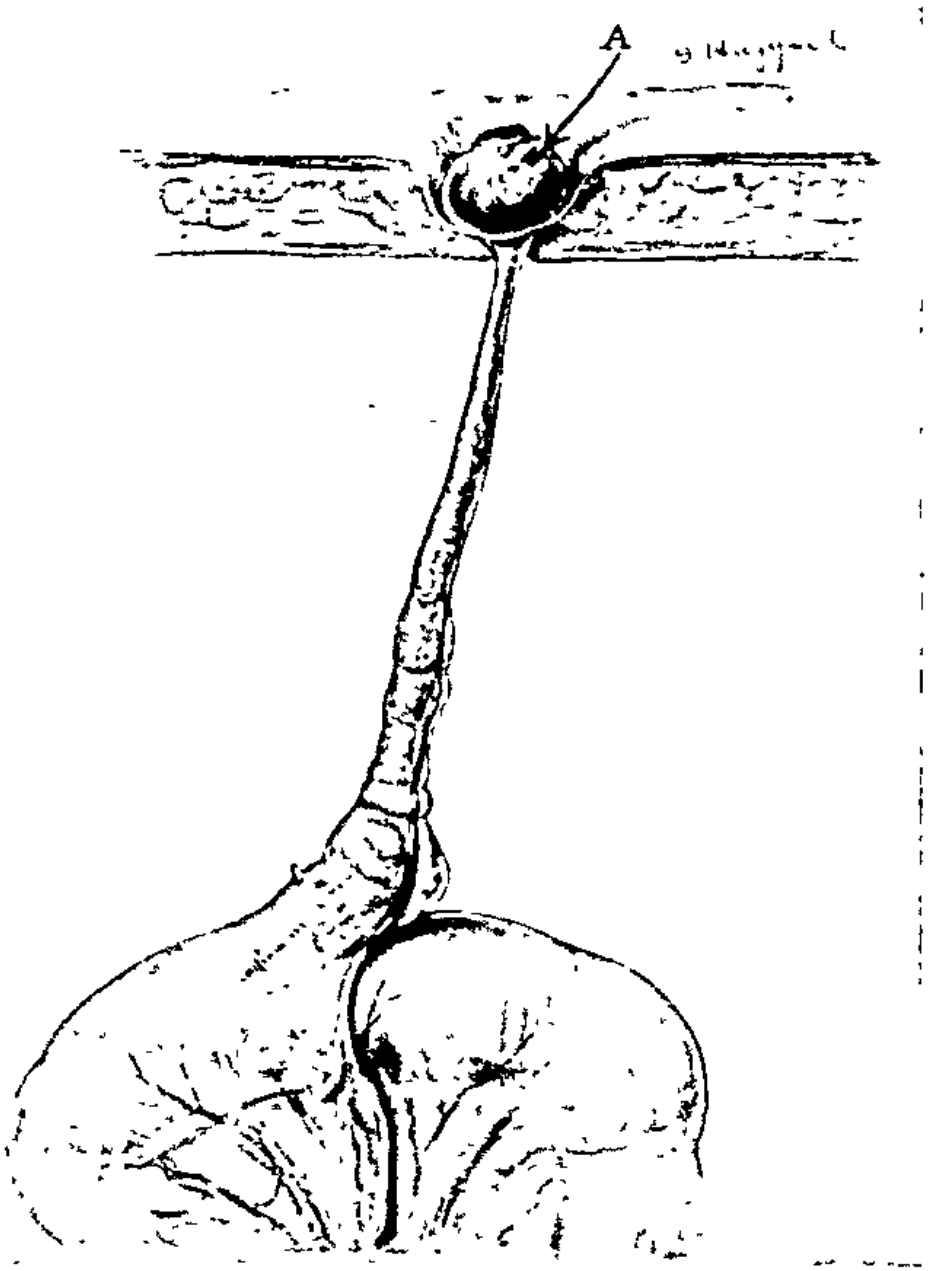

FIG. 351 —Drawing of Meckel's diverticulum showing its attachment to the umbilicus with its independent blood supply. Upper arrow (*A*) points to external opening

series were found because we routinely examine the terminal ileum in a cases in which the disease in the appendix is not sufficient to accoun for all of the clinical picture. This examination is done not only in infan but in adults as well. In our series we have seen eight instances inflammation of this type. The patients have ranged from 12 months

age to 9 years The majority of these patients were past infancy In three of the patients a perforation was found at operation, one of these patients succumbed, having had symptoms forty hours prior to operation

CASE III —A 6 year old boy was admitted to the hospital because of abdominal pain of intermittent character of two weeks' duration It was stated that he had been passing clotted blood for three days The hemoglobin on admission was 7 6 gm A provisional diagnosis of Meckel's diverticulum or intestinal polyp as the cause of the bleeding was considered A gastrointestinal series, sigmoidoscopy and barium enema proved to be negative A laparotomy was performed and an inflamed Meckel's diverticulum was found in the ileum 20 inches from the ileocecal valve The diverticulum measured 4 by 2 5 cm Because of the size of the stoma it was necessary to resect 16 cm of the ileum including the Meckel's diverticulum, and an end-to-end anastomosis was performed Microscopic examination was reported as Meckel's diverticulum with acute and chronic inflammation The postoperative course was uneventful

CASE IV —A $5\frac{1}{2}$ year old girl was admitted to the hospital with a history of generalized abdominal pain, nausea and vomiting of thirty-six hours' duration There was localized tenderness and muscle spasm in the right lower quadrant A preoperative diagnosis of acute appendicitis was made Laparotomy revealed a normal appendix On further exploration a Meckel's diverticulum 2 cm. long was found in the ileum and grossly showed inflammation at its tip Diverticulectomy was performed Microscopic examination of the tissue revealed aberrant pancreatic tissue in gastric mucosa in the Meckel's diverticulum but no definite ulceration The convalescence was uneventful

CASE V —A male child, 16 months of age, was admitted to the hospital because of abdominal pain of twelve hours' duration, with nausea and vomiting Examination revealed a temperature of 103° F (rectal) There was diffuse lower abdominal tenderness and muscle spasm A preoperative diagnosis of acute appendicitis was made Laparotomy disclosed a normal appendix and on exploration of the ileum a Meckel's diverticulum 12 inches away from the ileocecal junction was removed Microscopic examination revealed acute inflammation of the Meckel's diverticulum The postoperative recovery was uneventful

CASE VI —An 8 year old boy was admitted to the hospital with a history of generalized abdominal pain, nausea, vomiting and high fever of forty hours' duration. Examination revealed generalized abdominal tenderness, rigidity and distention. A diagnosis of perforated appendix with peritonitis was made Laparotomy revealed a normal appendix and a ruptured Meckel's diverticulum with abscess formation Diverticulectomy and drainage were performed The patient expired twenty-four hours postoperatively as a result of his fulminating peritonitis.

As has been previously stated, all of these cases had been preoperatively diagnosed as appendicitis and the Meckel's diverticulum was

found upon examination of the terminal ileum. This emphasizes the difficulty in making a correct diagnosis of the Meckel's diverticulum preoperatively since the symptoms and findings are so similar to the more common disease, acute appendicitis. If this condition is kept in mind and searched for in cases where the appendix does not appear to account for all the clinical findings, it matters little that the diagnosis is made preoperatively, since both conditions require laparotomy. Whether diverticulectomy or resection of the ileum, including the Meckel's diverticulum, is done depends upon the individual lesion found. If the mouth of the diverticulum is small enough so that a V-shaped segment of the ileum can be removed beneath the diverticulum and permit closure of the defect without constriction, this procedure is the one of choice. When, however, the opening of the diverticulum into the gut is too large to permit resection of this segment at a 45 degree angle, it is a better procedure to resect the involved ileum. Appendectomy should likewise be performed if the general condition of the patient permits. Peritonitis following a ruptured Meckel's diverticulum is known to be of a much more lethal character than that accompanying a perforated appendix. The reason for this is that the diverticulum lies farther away from the lateral wall and the process of walling off is not so easily accomplished, and the fluid content of the gut is more fluid and of greater quantity. Accordingly a perforation in a Meckel's diverticulum more nearly approaches the problem of a ruptured hollow viscus and yet has many of the features of appendicitis as well

HEMORRHAGE

Hemorrhage resulting from Meckel's diverticulum occurs in two forms in infants and children, either as acute massive hemorrhage or recurrent mild bleeding episodes It is usually due to ulceration of heterotopic gastric or pancreatic tissue present in the diverticulum. The acute massive hemorrhages are mainly found in infants under 2 years of age and the bleeding may be of such degree that the patient may develop hemorrhagic shock. This type of bleeding is practically always unassociated with abdominal pain, in contradistinction to hemorrhage associated with intussusception. While this complication is usually observed in infants under 2 years old, we have seen rare instances in the late teen age group, and it may occur in adults. Other causes of bleeding in children from the gastrointestinal tract must be considered, such as the hemorrhagic diseases, isolated polyps in the colon and intussusception. Isolated polyps in the colon can be easily ruled out by sigmoidoscopic examination and barium air contrast media. Likewise, intussusception can be ruled out by the history of crampy abdominal pain associated with

blood mixed with stool and the presence of a palpable mass. Intussusception of the ileo-ileo type rarely produces bleeding of great significance unless it becomes an ileocecal type or double intussusception, and then a mass is palpable. We have seen seven cases of bleeding from a Meckel's diverticulum in infants and children, all of them being under 2 years of age, the youngest being 4½ months. All of these cases were diagnosed correctly. The diagnosis is not difficult if one realizes that it is the most common cause of massive, painless bleeding into the bowel in infants under 2 years of age.

CASE VII.—A female child, 7½ months of age, was admitted to the hospital with episodes of vomiting and blood in the stool of three days' duration. This patient had had three previous admissions to other hospitals during the past two months and no definite diagnosis had been made as to the cause of melena. The hemoglobin on admission was 4.1 gm. The patient was transfused with 150 cc. of blood. A preoperative diagnosis of hemorrhage from a Meckel's diverticulum was made and laparotomy revealed a Meckel's diverticulum 2.5 by 1.5 cm. The stoma was large, therefore a diverticulectomy was not feasible, a resection of the ileum bearing the Meckel's diverticulum was carried out with a side-to-side anastomosis of the proximal and distal segments of the ileum and the bowel ends were closed. Microscopic examination revealed a peptic ulcer in the Meckel's diverticulum bearing gastric mucosa. The postoperative recovery was uneventful.

CASE VIII.—A 9 months old female child was admitted to the hospital with hemorrhage of the bowel of twenty-four hours' duration. Hemoglobin was 6.0 gm. Transfusion of 130 cc. of blood was given preoperatively. The preoperative diagnosis was hemorrhage from a Meckel's diverticulum. Laparotomy was carried out twelve hours after admission and a continuous transfusion was given during the operative procedure. A Meckel's diverticulum was found in the ileum and diverticulectomy performed. Microscopic examination revealed a shallow ulcer on the lateral wall of the diverticulum which extended to the submucosa. No definite gastric mucosa was seen in the sections. Operative recovery was uneventful.

CASE IX.—A 7 months old male child was admitted to the hospital because of recurrent bleeding from the rectum for the past few months. The hemoglobin on admission was 7.2 gm. Following two transfusions the hemoglobin was 10.6 gm. A preoperative diagnosis of hemorrhage from a Meckel's diverticulum was made and operation was carried out the day following admission. Laparotomy disclosed a Meckel's diverticulum 2.5 by 1.5 cm., 15 inches away from the ileocecal junction. Diverticulectomy was performed. Microscopic examination revealed a perforating ulcer of the diverticulum with gastric mucosa. The ulcer was in the distal portion of the Meckel's diverticulum and measured 8 by 6 mm. Operative recovery was uneventful.

Infants admitted to the hospital with severe hemorrhage into the

gastrointestinal tract often have a hemoglobin of 4 to 6 gm. per 100 cc. and under such circumstances are poor operative risks. These patients require blood transfusions preparatory to operation and it is our practice to give them sufficient blood to develop a hemoglobin level of at least 8 to 10 gm. before undertaking laparotomy. This regimen has proved to be a safe one because the bleeding usually subsides following transfusion and the operation can be done after a period of six to eight hours has elapsed, or if necessary, later when the patient is a much improved operative risk. The cases which we have presented emphasize the typical history and findings in this type of lesion. The patient is an infant usually under 2 years of age; the bleeding is unassociated with abdominal pain, and the bowel movements are usually composed of blood. Of the seven cases in this group, all save one showed heterotopic tissue.

INTUSSUSCEPTION

Meckel's diverticulum is not a common cause of intussusception. It rarely occurs and we have seen but two instances. In those patients who have an intussusception caused by a Meckel's diverticulum, the obstruction is practically always sudden and complete. In contrast, the obstruction in the ileocolic type of intussusception as seen in infants develops more slowly. The presence of a Meckel's diverticulum should be suspected when the operative reduction of the intussuscipiens is more difficult than usual. The diverticulum was not attached to the anterior abdominal wall in either of the cases which we have seen. Should such occur, the cecum should be drawn toward the midline.

CASE X.—A 4½ year old boy was admitted to the hospital with a history of generalized abdominal pain of twenty-four hours' duration, with nausea and vomiting. Examination revealed a sausage-shaped mass in the right lower quadrant. A preoperative diagnosis of intussusception was made and laparotomy revealed an ileo-ileo intussusception which had become ileocecal. The reduction of the intussusception was difficult and when the proximal portion was completely reduced, a Meckel's diverticulum was found as the cause of the intussusception The diverticulum was 12 inches from the ileocecal junction. Diverticulectomy was performed and microscopic examination revealed acute inflammation and hemorrhage of the Meckel's diverticulum compatible with intussusception. The operative recovery was uneventful.

CASE XI.—A male child, 9 months of age, was admitted to the hospital with a history of having been in good health up to eight hours previously. It was apparent that the child had abdominal pain and it was reported to have vomited. During the period of eight hours the child cried out because of frequent cramp-like pains and would lie in the knee-chest position on his side. There was no passage of stool or blood from the rectum. Physical examination on admission

showed an acutely ill child, pale in appearance, restless and crying out as if in pain. The abdomen was soft and a nontender, sausage-like mass was easily palpated in the right lower quadrant The red blood count was 4,220,000, the white blood count was 16,100, with 79 per cent neutrophils Intravenous fluids were given prior to surgery Preoperative diagnosis was intussusception and possible volvulus At operation intussusception was found of the ileocecal type; this included the Meckel's diverticulum which was invaginated Reduction of the intussusception and resection of the Meckel's diverticulum was accomplished A blood transfusion of 200 cc was given after operation Pathological report showed infarction of Meckel's diverticulum, no aberrant gastric mucosa. The postoperative course was uneventful

When the intussusception is reduced, the diverticulum should then be excised If resection of the ileum and the diverticulum becomes necessary because of irreducibility, the mortality rate is relatively high in these young infants Resection may also be indicated because of gangrenous bowel. In this type of obstruction the obstruction becomes complete early with early strangulation of the involved gut

INTESTINAL OBSTRUCTION

Internal strangulation of the intestines due to the presence of a Meckel's diverticulum is occasionally seen as a cause of intestinal obstruction. This complication is more commonly seen in older children and adults. The diverticulum may be attached to a loop of small bowel or it may be attached to the umbilicus (Fig 351) The diverticulum usually acts either as an axis about which the bowel may rotate to form a volvulus or it may form a band over which a loop of bowel may pass through the opening made by the diverticulum and adjacent structure Various forms of internal strangulation are therefore possible.

The prognosis for this group of patients depends upon the early adequate surgical treatment of the associated small bowel obstruction The signs and symptoms of intestinal obstruction due to Meckel's diverticulum are those of small bowel mechanical obstruction with strangulation Flat plates of the abdomen with the patient in the upright and recumbent positions are of value as a diagnostic aid Patients who come into the hospital with a moderate degree of abdominal distention should have preliminary intestinal decompression and adequate fluid replacement to render them better operative risks When strangulation is present this need not require a great deal of time, it should not consume more than a few hours. In the event a volvulus is found it is untwisted and reduced in addition to diverticulectomy In strangulation of the intestine by Meckel's diverticulum or its associated band formations, release of the obstruction is a simple matter by severing the bands Unfortunately

this type of obstruction develops rapidly, and since strangulation plays such a major role, many of these patients come to operation with gangrene of the bowel already present, making resection of the involved portion of the intestine mandatory.

CASE XII.—A 4½ year old boy was admitted to the hospital with generalized abdominal pain, nausea and vomiting of forty-eight hours' duration. There was tenderness and rigidity of the lower right abdomen. Preoperative diagnosis of acute perforated appendicitis with peritonitis was made. Laparotomy revealed a Meckel's diverticulum 15 inches from the ileocecal junction. It was attached to the umbilicus. Microscopic examination showed a Meckel's diverticulum. Diverticulectomy and excision of the umbilicus was performed. Recovery was uneventful.

CASE XIII.—A 9 year old boy was admitted to the hospital with a history of tumor of the umbilicus since birth. There had been no discharge. The child complained of generalized abdominal pain, nausea and vomiting on two previous episodes during the past year. The duration of each episode was forty-eight hours. On this admission the patient had been ill for forty-eight hours and examination revealed a temperature of 102° F., general abdominal distention and tenderness. A preoperative diagnosis of intestinal obstruction with peritonitis was made. Laparotomy revealed an internal intestinal obstruction, a loop of ileum being twisted by a band as a remnant of a Meckel's diverticulum. The ileum was gangrenous and perforated, necessitating a resection and end-to-end anastomosis and proximal enterostomy. Microscopic examination revealed remnant of vitelline duct. The patient died four hours postoperatively of shock and peritonitis.

CASE XIV.—An 11 year old boy was admitted to the hospital because of generalized abdominal pain, nausea and vomiting of forty hours' duration. Examination revealed generalized abdominal distention and clinical signs of peritonitis. Laparotomy revealed a gangrenous ileum, secondary to an internal obstruction from a band representing the remnant of the vitelline duct. A resection of the gangrenous ileum and an end-to-end anastomosis of the proximal enterostomy was performed. Operative period was complicated by secondary small bowel obstruction and the patient died on the sixteenth postoperative day from the latter complication.

From a review of the above patients, it is evident that this is a complication seen in the older child. The mortality rate is high because strangulation of the gut takes place early in this type of obstruction and these patients are not seen by the surgeon early in the course of their intestinal obstruction. The outlook should be better when release of the obstruction is obtained before gangrene has become definite.

GENERAL COMMENTS

The presence of a Meckel's diverticulum in itself is not of any great moment, but the complications that may arise from its presence, especially in children, are serious. Its presence, and the possible complications, should be considered in the diagnosis and treatment of every acute abdomen.

In performing diverticulectomy, the decision as to simple diverticulectomy or intestinal resection is a decision that must be made on the individual lesion by the surgeon Diverticulectomy, with clamps applied at 45 degree angles to the longitudinal axis of the ileum, is of paramount importance, as closure with a continuous suture which penetrates all layers except the mucosa, reinforced by interrupted Halsted mattress sutures, enables one to close the defect without constriction in the vast majority of cases This has been well shown by Ladd and Gross.[4] The purse-string type of closure is to be condemned because of the danger of subsequent constriction, postoperative obstruction, and occasionally perforation at the site of closure. In those patients who have a stoma so large that the clamps form an angle greater than 45 degrees when they are applied on either side of the diverticulum, it is likely that the approximation of the gut at the base of the diverticulum will cause a dilatation to form in the gut at this point In such cases, resection of the involved ileum including the Meckel's diverticulum is a preferred procedure.

It is to be remembered that there is always an independent artery and vein supplying the Meckel's diverticulum itself, as shown in Figure 351. This vessel should always be ligated before performing the diverticulectomy In young infants the lumen of the intestine is quite small and a side-to-side anastomosis affords a broader serosa-to-serosa approximation, and for this reason is probably a safeer type of anastomosis in most hands If an end-to-end anastomosis is to be made in the intestinal tract, care must be exercised not to cause constriction of the gut at the suture line In order to do this, clamps should be placed at an angle *rather than directly across the gut.*

SUMMARY

A discussion of the complications of Meckel's diverticulum has been presented from a study of twenty-two cases. The major complications of Meckel's diverticulum are (1) umbilical discharge or cystic tumor, (2) inflammation and perforation, (3) acute hemorrhage, (4) intussusception and (5) intestinal obstruction In any acute intra-abdominal condition in infants and children it is important that the embryology and anatomy of the Meckel's diverticulum, as well as the complications which arise in or about this anomaly, be understood.

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CLINICS ON OTHER SUBJECTS

LOW BACK PAIN AND SCIATICA FROM A CONSERVATIVE STANDPOINT

FREDERICK C KIDNER, M D., F A C.S *

THE opening sentence of the first lecture in physiology delivered to my freshman class was as follows: "The human body is the result of a concatination of circumstances which every good physiologist must admit has produced an eminently poor mechanism." This statement is not true A paraphrase of it reads as follows The human spine is the result of a concatination of circumstances which every good surgeon must admit has produced an eminently complicated mechanism. This is true, and accounts for the confusion which exists in the diagnosis and treatment of back pain

ANATOMY

The lower spine of the human being and its pelvic attachments are made up of a number of bones, joints, cartilages, ligaments, muscles, nerves and blood vessels which vary in their relationships to each other in each individual. Of the various structures, those most often the cause of pain are the lateral articulations, the sacroiliac joints, the intervertebral disks and the nerve roots as they emerge from the spinal canal

At best, the structures which were designed to function in the horizontal position of the quadruped are handicapped by the great mechanical strains incident to the change to the erect position of the biped. Instead of being supported at both ends, they are supported only at the lower or pelvic end The fact that the sacrum remains in an oblique position adds greatly to the mechanical strain, in that the spine tends constantly to slip forward and to return to the original horizontal position.

DIAGNOSIS

Each of the structures of the lower back is subject to the same ills to which similar structures are subject elsewhere in the body. The bones are subject to fracture, disease, tuberculosis, syphilis, or irritative overgrowth. The joints are subject to strain, sprain, dislocation, or disease. The disks may be ruptured, as demonstrated by the displaced nucleus pulposus. The ligaments may be torn. The muscles may be torn

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or infected. The nerves may be torn by injury or pressed upon by spinal cord tumors, by a displaced nucleus pulposus, by damaged or diseased bone, or by damaged ligaments Finally, the blood vessels may be torn or undergo degenerative changes. All these pathologic states are accompanied by signs and symptoms, just as they are when they occur elsewhere in the body.

Unfortunately, these signs are difficult to recognize because the structures are so deeply buried that their abnormalities cannot be felt or seen by the examiner, except in the gross deformities of fracture, spondylolisthesis or scoliosis. Thus, the fluid which collects in a sprained lumbosacral joint cannot be recognized, as can the fluid in a sprained ankle. The hypertrophic nodules which may surround that joint cannot be felt as they can be in a knee joint, the seat of advanced hypertrophic arthritis

The symptoms, too, which result from pathologic processes in the structures of the lower back are hard to analyze and classify, because from their position and distribution they may originate from any one of the structures which are in such close contact. Thus, an acute pain referred to the right side of the lumbosacral area may have its origin in a partially ruptured muscle, a sprained sacroiliac or lumbosacral joint, in an overstretched band of fascia, or in an acute infectious process. A chronic low median back pain may be the result of the chronic strain of bad posture, of absorption from an infected prostate, or tuberculosis of the fifth lumbar vertebra Pain in the distribution of one of the major nerves to the leg may be due to a cord tumor, rarely to a true neuritis, to pressure on a nerve root at the foramen of exit by a swollen, diseased or damaged lateral articulation, or by a displaced nucleus pulposus Under such circumstances it is plain to see why accurate diagnosis of back conditions is difficult, and why the ruptured intervertebral disk has been so widely seized upon as a tangible and simple explanation for all sciaticas, and by some individuals for all backaches.

This point of view simplified the problem too much. We must remember that ever since Goldthwait began to talk about the sacroiliac joint in 1900, and ever since the osteopaths began to make their apparently miraculous cures of acute backache by manipulation, the great majority of sufferers from low back pain have been cured, or sufficiently relieved to allow them to carry on a fairly normal life by conservative methods, manipulation, massage, heat, but above all, by rest, partial or complete.

SOME CAUSES OF BACKACHE

Now let us consider, first, some of the causes of acute backache, with their diagnosis and treatment; and, then, the chronic backaches with or without sciatica. Much of an article on the prevention and treatment

of athletic injuries by Bearzy[1] might well be inserted here, because the causes of acute backache in ordinary life are so like those of the extremities and backs in athletes—strains, contusions, sprains, fractures and inflammations. The vast majority of these occur in men who do heavy work though, because of the instability of the lower back, minor twists or efforts may cause them. Prevention of these injuries depends, as in the athlete, on training of the muscles of the back to carry the load of the daily job Fortunately, this training is automatic in most laborers.

Muscular Strain.—The commonest cause of symptoms in the acute backache of sudden onset, I believe to be muscular strain. A man's foot slips as he stoops to lift a heavy object—a sharp pain occurs in the lower lumbar region, often with a snapping sensation. The individual is momentarily unable to straighten up and the pain is severe. He is inclined to laugh and tells his mates that he has a "crick in the back." This he endeavors to relieve by stretching and squirming. If this does not bring relief, he reports to First Aid, where he is given some form of heat treatment which tend to increase hemorrhage and exudate. He should receive cold packs, which tend to reduce hemorrhage and exudate in the damaged tissue. He goes home and to bed. If the pain is not too bad the next morning, he reports for work and gets his friends to help him through the day's tasks. From day to day his condition improves, and in two to three weeks, except in severe cases, he is well. He would have recovered much more rapidly had he stayed in bed. This man had a muscle strain or, more accurately, an actual overstretching and tear of a greater or smaller number of muscle fibers. He got well because the great masses of undamaged muscles protected and took up the work of the damaged fibers until they could heal. How is the diagnosis made in such a case? By the history by localized tenderness over the damaged area, and by protective muscle spasm there, and there only.

Joint Sprains.—The second most common cause of acute low backache is a true joint sprain, usually of the lateral intervertebral articulations, but occasionally of the sacroiliac. These sprains may, because of the poor mechanics of the lumbosacral spine, be caused by slight injuries, but more commonly are caused by severe ones, such as unusually heavy lifting. At any rate, the injury must be of such a character that it overcomes the protective action of the muscles and acts directly on the joint to cause a partial rupture of its ligaments.

Symptoms and Signs.—At first, the symptoms and signs, localized pain and tenderness and localized muscle spasm, are indistinguishable from the muscle strain Within a few hours other signs and symptoms develop which are directly traceable to the joint changes They are exactly like the changes in a sprained ankle except that they cannot be seen or felt.

Therefore, they are apt to be made light of or actually ignored, both by the patient and by the medical attendant. They should be recognized promptly and treated with the same attention as is an acutely sprained ankle They can be recognized, first, by increasing local pain due to the pressure of the fluid caused by the traumatic synovitis, second, by increasing widespread muscle spasm, which often produces a scoliosis, third, by increasing localized tenderness, fourth, by the appearance of limitation of straight leg raising, crossed leg limitation, hyperextension of the thigh limitation—all of which are based on the efforts of various muscle groups to protect the damaged joint, and, fifth, by the most controversial sign—the appearance of some form of radiating nerve pain, usually along the distribution of the fifth lumbar, the first or second sacral nerve. If the damage to the affected joint is sufficiently severe, nerve pressure may cause, as a sixth sign, loss of ankle or knee jerk, or even a peroneal palsy.

At this point we come into direct disagreement with the proponents of the ruptured disk and extruded nucleus pulposus, who maintain that the above six groups of signs and symptoms are always caused by a displaced nucleus It is my contention and considered opinion that these six groups of signs and symptoms are, in the vast majority of cases, due to acute or chronic changes in and around the lateral or sacroiliac articulations which produce pressure on a nerve as it passes through the intervertebral foramen or across a damaged sacroiliac.

Treatment.—If the acute sprains are improperly treated, chronic changes in the joints occur in every way like those in the improperly treated sprained ankle of the athlete or laborer. Proper treatment in both cases consists of complete rest This can be obtained for the back cases only in a bed properly prepared (Figs 352, 353) If complete rest is neglected and chronic changes are allowed to ensue, chronic painful backs will result which lead to tremendous economic loss to laborers, employers and insurance companies, and to much discomfort among people in the higher financial brackets. These changes consist of capsular thickening, cartilage atrophy and bony overgrowths Secondary to these are muscle and fascia overstrain and fibrositis, and frequently chronic nerve irritation, with referred pain and reflex reduction or loss. These chronic cases are often diagnosed as displaced nucleus pulposus, from which they are very difficult to distinguish. In my opinion, only good positive myelograms prove the existence of the displaced nucleus

When the chronic changes in the low back following sprain are once established, recurring or constant backache is inevitable unless proper treatment is persistently carried out. This treatment must be directed first to the damaged joint, and consists essentially of complete bed rest,

as in the acute cases, until pain subsides. This must be followed by the partial rest provided by plaster of paris, or by an efficient brace. These give the joint a chance to heal and allow the swelling and thickening to go down, thereby relieving pressure on nerves. The secondary changes in the muscles and fascia require massage, heat and manipulation. These

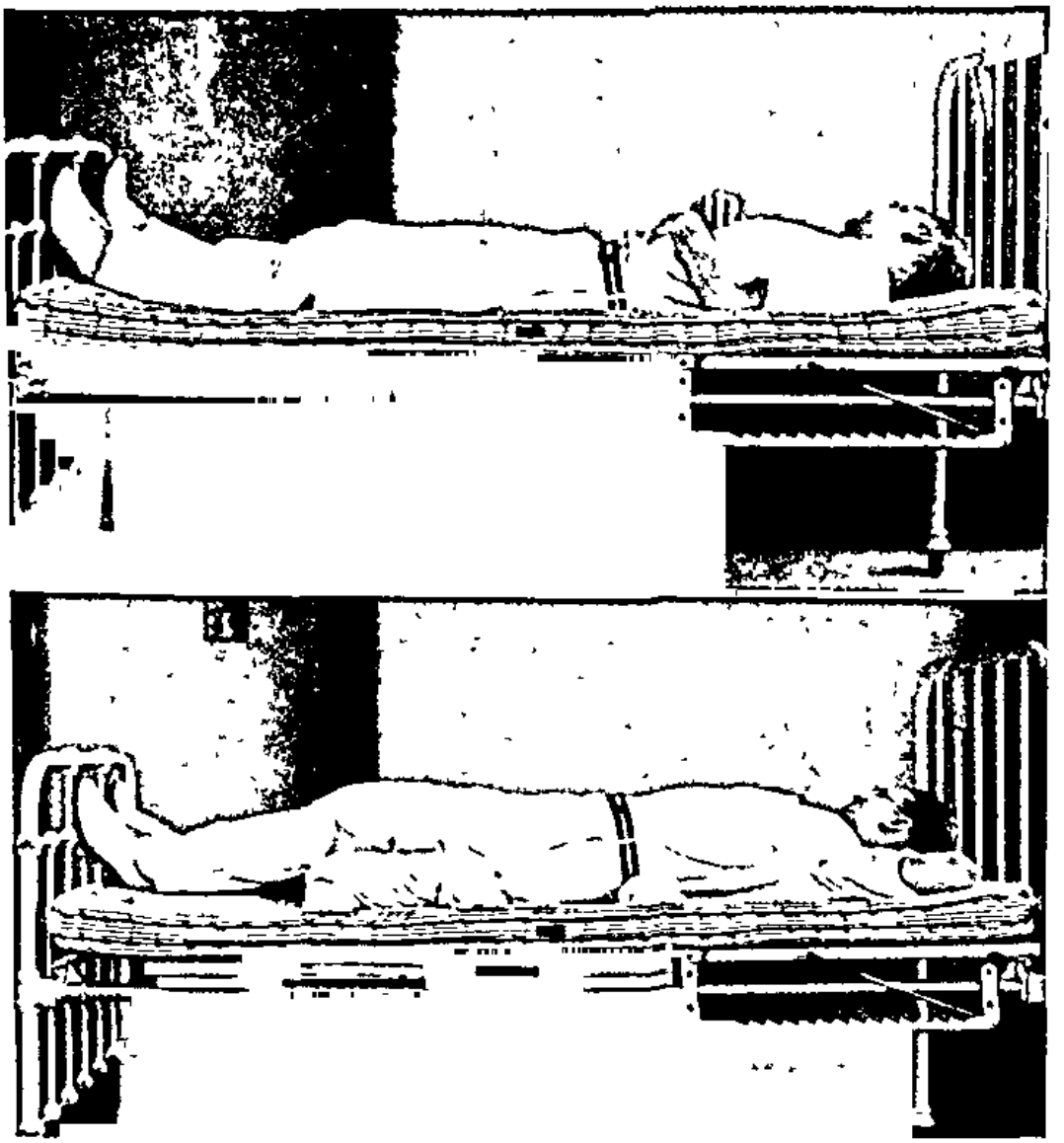

Fig 352 Fig 353

Fig. 352.—Poor position for treatment of backache

Fig. 353 —Good position for treatment of backache

procedures, if properly carried out, usually lead to a reconstructed and useful back In the obstinate cases, surgical fusion may be necessary

Some of the details of the treatment are, first, the proper type of bed, as illustrated. In my experience, traction on the legs and head while in bed, which is intended to remove pressure from the affected parts, is of

injury produces acute symptoms by damaging soft parts. Because of the injury an x-ray examination is made which may show so much disease that absence of previous disability is hard to understand. There are two explanations of these comparatively symptomless cases. First, the distribution of the pathological changes in relatively nonsensitive areas; and, second, the tendency to the formation of protective bone bridges from vertebra to vertebra, which immobilize the affected segments and thereby stop irritation

Fig. 354

Fig 355.

Fig. 354.—Anteroposterior view of my own back, showing degenerative changes taking place over many years, with complete destruction of discs No sciatica and only moderate backache was present.

Fig. 355.—Lateral view of same patient.

Many of these relatively symptomless backs appear in the compensation courts after an acute minor injury, of the type which would get well if the back were normal. Severe pain and disability persist. Almost invariably the case is decided in favor of the injured man, and compensation is continued indefinitely. Such decisions are probably correct. They are based on the theory that, although the backs were not painful prior to the accident, the injury has upset the habitual comfortable balance of the spine, which the x-rays plainly show to be abnormal.

Many of these backs, due to wear and tear changes, are painful and disabling. From the point of view of treatment, they are to be classed

with the cases previously described as chronic joint sprain. Treatment of both types must begin by removal of causes of irritation and strain The laborer must get a lighter job The golfer must quit, develop a smoother stroke, or suffer the consequences, which many do The removal of strain may alone be enough to make the patient bearably comfortable. If this is not enough, then some type of brace must be worn, ranging in supporting efficiency from a simple belt to a back-length brace Combined with these, application of heat and the use of a hard bed are helpful

Fusion —As a last resort, fusion by means of one of the many types of operation must be undertaken. Which type is best depends on the surgeon's judgment as to the operation he personally can use best to produce the strongest and most efficient fixation in the individual case

Spinal fusion by surgical means began with Albee's tibial graft placed in the groove made by splitting the spinous processes, and Hibb's fixation of the lateral articulations, accompanied by overlapping of broken up fragments of the spinous processes and laminae All other operations for fusion, and there are many, are based on these two Tibial, pelvic or rib grafts are used, cut in various shapes and applied in various ways, but all including parts of the original Albee and Hibbs procedure All are difficult and subject to failure. They must be skillfully done

Systemic Infection.—Backache sometimes results from inflammatory changes caused by infectious processes elsewhere, especially abscessed teeth or infected prostates Sometimes these are accompanied by sciatica, the result of true neuritis. I do not believe that this type is common, but thorough examination to find a source of infection should always be made.

The days of wholesale removal of suspected teeth to cure backache are fortunately over, yet, it is surprising to see the rapidity with which the occasional patient gets well after the extraction of a frankly abscessed tooth or a course of prostate massage True gonorrheal arthritis is occasionally responsible for low back pain.

Fractures.—Fractures of the bodies of vertebrae with compression, if not fully corrected, cause persistent pain of several sorts: muscular, because of the protective spasm incident to the effort of the muscles to overcome the deformity, to immobilize the damaged ligaments and intervertebral disks, and to immobilize the lateral articulations which are thrown out of line by the bone deformity, ligamentous pain, due to stretching of the ligaments by the bone deformity; nerve pain, either local or referred, the result of pressure from the deformity of the foramina of exit.

All fractures of the vertebral bodies should be reduced. If the x-ray

shows simple compression without injury to the laminae and the patient is in good shape, the reduction should be done at once. The simplest method is to lay the patient on a table on his face, after giving him a moderate dose of morphine. With the left hand under the patient's chest and the heel of the right hand over the fracture, strong sharp upward pressure of the left hand is combined with sharp downward pressure of the right. After this reduction the patient is placed on a hyperextended Bradford frame until the ileus, which usually accompanies these injuries, disappears. He is then placed in a hyperextending plaster jacket for three months.

If the x-ray shows damage to the laminae or comminution of the fracture, reduction should be gradual. The easiest way to accomplish this is by placing the patient on his back on a moderately extended Bradford frame with light head and foot traction. As the patient improves the hyperextension should be increased. A second Bradford frame with a reverse curve should be provided so that the patient may be rolled on his face for rest and skin care, and the hyperextension maintained.

Fractures of the laminae or articular facets are occasional sources of referred nerve pain. These are apt to be overlooked because only the adequate x-ray examinations reveal them.

Congenital Abnormalities or Lesions.—Anterior spondylolisthesis, most common at the lumbosacral junction, probably is in the great majority of cases a congenital lesion caused by failure of the laminae or pedicles to close properly. It often is symptomless until some trauma puts excessive strain on the imperfect parts, then irritative pain, either local or referred, develops. Traumatic spondylolisthesis may occur through fracture of the laminae or pedicles, but it is rare. When this lesion is found in young people, it is usually because of complaint of low persistent pain in the midline about the top of the sacrum, which is made worse by activity. This may be accompanied by sciatica if the forward displacement of the fifth lumbar is great enough to cause angulation with pressure on the first or second sacral roots as they emerge from the canal. When found in these young people, the question arises whether the lesion will remain static or become progressively worse. On the answer to this question depends the treatment. If we decide that it is a congenital affair, in which there is enough fusion of one or both laminae to prevent further slipping of the fifth lumbar, the treatment of choice is support of the back by a brace and close attention to posture to decrease lumbar lordosis, in the hope that the diastasis will fuse. Such protective treatment is always justified for a period of observation. If, however, the lesion tends to get worse, then spinal fusion is necessary. Such fusion is more difficult than in other lesions because of the necessity of bridging across the loose

bad posture The arrangements for treatment, except in special schools, are generally not so good. The tendency seems to be to place the bad posture cases in the routine gymnastic and setting-up drill classes, without providing enough special attention. Proper exercises will invariably, if persisted in, correct bad posture in children. Where it still exists in the adult, the problem is more difficult, but by no means hopeless Assuming that the symptoms are almost wholly due to muscular and ligamentous strain, we must direct our efforts to relief of that strain. The first step is to establish the habit of sleeping on a firm bed. In my experience, the use of the soft inner spring mattress tends to make all backaches, no matter what the cause, worse The next step is to provide some sort of support—corset, belt or full-fledged brace—to correct by mechanical means the bad posture and thus relieve the strain. The second step is to provide corrective exercises under skilled direction, which shall teach the tired muscles to regain their normal strength, and in so doing enable them to hold the body in normal equilibrium.

RUPTURED DISK

Now let me discuss the problems of the ruptured intervertebral disk and displaced nucleus pulposus *I admit that it occurs and that the* removal of the fragments of nucleus relieve, dramatically, intractable sciatic pain

I believe that the diagnosis of the condition is difficult to make and that it sometimes cannot be made with positiveness without the injection of an opaque medium into the spinal canal, and without succeeding positive x-rays Many surgeons who have had long and large experience, such as Mixter and Barr of Boston, Compere in Chicago, and others, agree with this statement. I cannot agree with my friend, Key, of St Louis, who says that the displaced nucleus pulposus is the first clear-cut and provable cause of backache and sciatica yet to be discovered Even though the x-ray findings point to the presence of a herniated nucleus, these findings are not always borne out at the time of the operation. Many cases, apparently cured by the removal of the nucleus, do recur, and require second and even third operations Many patients, although they are relieved of their sciatica by operation, continue to have partially or wholly disabling backache. This, I believe, is for the most part due to the malformation of the disk following the original injury, and to a lesser degree to the damage to the ligaments incident to the operative procedure. All patients should have a considerable period of conservative treatment before operation. Many of these men are not able to go back to heavy work.

This fact leads to the widespread discussion of the necessity of spinal fusion following removal of the nucleus. Those who remove many nuclei

do not like the idea of fusion because it makes the approach very difficult if a second operation is necessary. Others insist on fusion as the only way to prevent postoperative backache. Perhaps a middle course is the correct one; if the removal of the nucleus requires much damage to ligaments and appreciable removal of laminae, then fusion should be done.

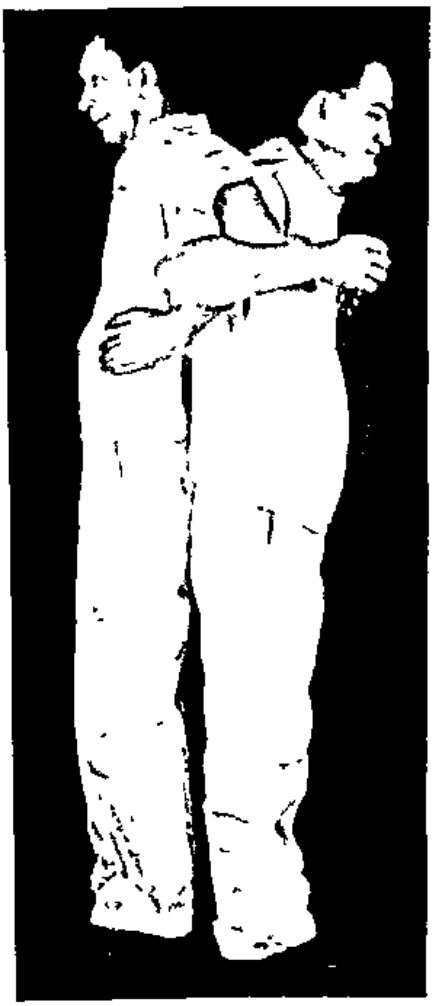

Fig 356.

Fig 357.

FIG. 356.—Method of grip for manipulation of acute back.
FIG. 357.—Manipulation for acute back.

ACUTE LOW BACKACHE DUE TO MINOR INJURY

There is a group of cases of acute low backache, often accompanied by sciatica, which show severe muscle spasm and sometimes acute fixed scoliosis. These result from injury, often of a very minor sort, such as stooping. They seem to depend on an acute subluxation of a sacroiliac or lumbosacral joint, without much ligament damage. They are the cases in which our friends, the osteopaths and chiropractors, obtain such startling results by manipulation, and which the orthopedic surgeon can do just as well. Their mechanism is not clear, but they are probably based on

fixation of a joint in abnormal positions, or possibly partial dislocations by muscle spasm. Stretching of these muscles by manipulation relaxes the spasm and allows the joints to return to the normal position. A useful maneuver for manipulation and correction of these cases follows: Stand back to back with the patient and grasp his elbows with yours Then, by bending forward lift him clear of the floor, with his back hyperextended over your buttocks (Figs. 356, 357) Then, with quick knee bend, shake him. He is apt to yell, but when placed on his feet again his pain may have disappeared

CONCLUSIONS

The vast majority of backaches are due to lesions exactly like those that occur in joints, bones, muscles and fasciae elsewhere.

Many cases of sciatica are due to the same lesions, because the lumbar and sacral nerve roots are in such close proximity to the affected tissues.

The vast majority of these cases can be cured by conservative means Of these, rest is the most important.

Rest may be obtained by recumbency on a firm bed, by various types of braces, each especially designed for the individual case, including the plaster jacket, and, as a last resort, by one of the many forms of surgical fusion.

Manipulation, with or without anesthesia, may obtain rest for the parts by breaking up adhesions or correcting faulty positions.

Corrective exercises, massage and heat may bring rest to the parts by correcting faulty posture and by improving the tone of the muscles and restoring satisfactory blood supply

* * *

This paper is frankly intended to restore the faith of the medical public in conservative treatment of backache and to help stem the rising tide of surgical intervention for the removal of the displaced nucleus pulposus.

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THE SURGERY OF KNEE JOINT DERANGEMENTS

CHARLES W. PEABODY, M.D. AND FRANK P. WALSH, M.D.

THE senior author finds himself looking back through a thirty year period of association with the development of orthopedics. This period has seen enlargement of the scope of knowledge and technics in the treatment of lesions of the musculoskeletal system to such an extent that it has become quite impossible for anyone not confined to the activities of this field of surgical science to keep pace with its development.

In such a period of time there are few areas in which the picture has changed and enlarged quite as much as in the surgery of the knee joint, and in particular as to those disturbances of functional integrity which can be classed not as diseases, but as those mechanically disturbing disorders which we are prone to classify together as internal derangements of the knee. It was around the beginning of this period that our British colleagues first demonstrated the practical feasibility of a surgical attack upon these disorders. Otherwise it was generally believed by the profession that operative intervention for these conditions was attended by too great uncertainty as to the outcome to be often indicated. Even today among the laity one encounters the supposition that an opening of the knee joint will lead to its ruin, and far from infrequently we find the laity quoting some professional advisor in support. Whether such advice stems from ignorance or from motivation may be still speculative. But even in military service (C. W. P.) it was common to find patients quoting similar advice from medical officers. It is probably indicated to face frankly the existence of walking monuments to the adage that some rush in where "angels" at least tread circumspectly.

In our surgical science of today, however, it is widely appreciated that knee joint surgery can be as dependable in results as routine *appendectomy. The factors that have permitted this achievement are* many; among them are clean anatomical dissection, meticulous aspetic safeguards, gentle and nontraumatic technic, and careful hemostasis and fine gauge suture material. As a secondary factor (and also a consequent one) synovitic reactions are absent or minimal, and early mobilization not only is practicable but basically indicated. Finally, as a corollary to early mobilization, has come acceptance of quadriceps muscle re-education to normal strength as an inescapable essential for the extrinsic stability of this intrinsically unstable articulation.

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However, in our contribution to this clinic the writers envision their particular challenge to be to point out the application of another factor which is building for maximum achievement in knee joint surgery for internal derangements, namely, preoperative diagnosis—the estimate of the situation which will lead to the most intelligent surgical planning as to operative approach and management of the deranging factor or factors.

Not so very long ago it was a custom to speak of this type of joint trouble of the knee as a "Pandora's box" You opened it and were prone to be not only surprised but disconcerted by what it revealed, or seemed to It was probably a period not much more removed in time that something similar tended to prevail as to abdominal operations—a time when exploratory laparotomy was the most frequently seen listing on surgical schedules Today an approach such as might be connoted by the term "exploratory arthrotomy" should carry the same implications. But the analogy differs in that closely accurate preoperative diagnosis in knee joint work stems to a very small degree from extensive clinical aids, but in the main from anatomical, pathological and physiological knowledge associated with the diagnostic acumen attained by experience and thorough analysis of symptoms and physical findings.

ANATOMY OF KNEE JOINT

Let us proceed, then, first with a quick glance at the anatomical structures with which we are dealing[1] (Figs. 358–361) First visualize the knee not as a true hinged joint, but one in which the tibial tuberosities glide in an arc of over ninety degrees around the axis of the femoral condyles Next we must appreciate that the intrinsic ligamentous apparatus, namely the posterior capsular ligament, the mesial collateral (tibial), the lateral collateral (fibular) and the two cruciates are structures each of which are taut only in certain phases of joint action. As a result this joint has flexibility not only in flexion and extension, but also in certain postures toward some side play and considerable torsional rotation. We must note in the latter connection that a pivot joint is provided through the socket formed by the thick high-rimmed and nearly circular lateral meniscus, which is quite securely tethered to the tibial plateau, while a greater gliding space is provided by the more semilunar shaped mesial meniscus, which in turn is more mobile on the tibial plateau

Note also that this mesial meniscus, unlike its fellow, is rather intimately attached to the posterior Y branch of the tibial ligament so that it may slide backward a little with the tibia as it glides back around the greater arc of the mesial femoral condyle. This mesial meniscus is seen to be narrow anteriorly but wide posteriorly; and when both flexion and

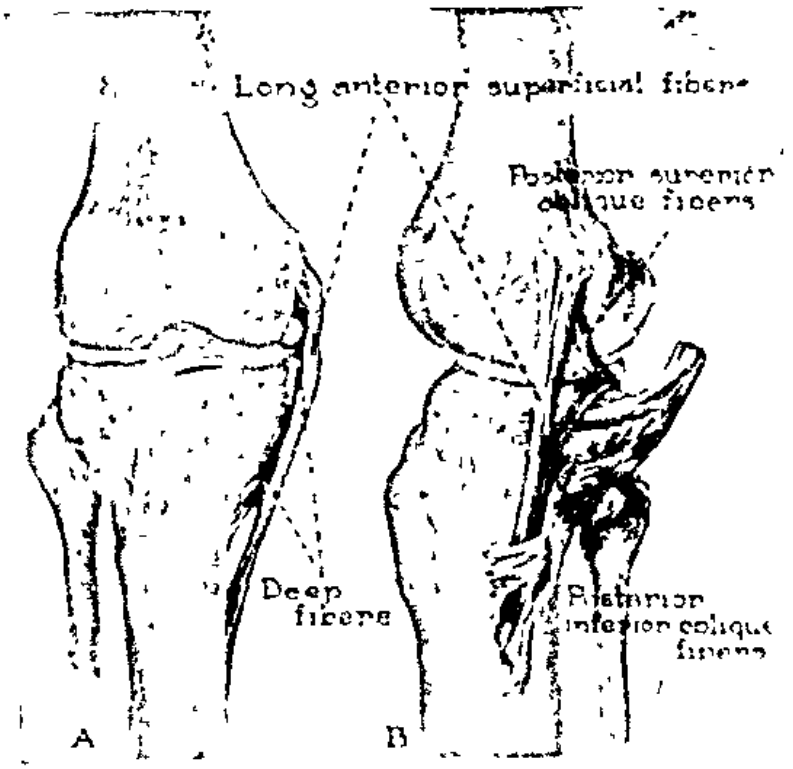

FIG 358.—Tibial collateral ligament in extension of the knee
(Abbott et al., J. Bone & Joint Surg., Vol. 26)

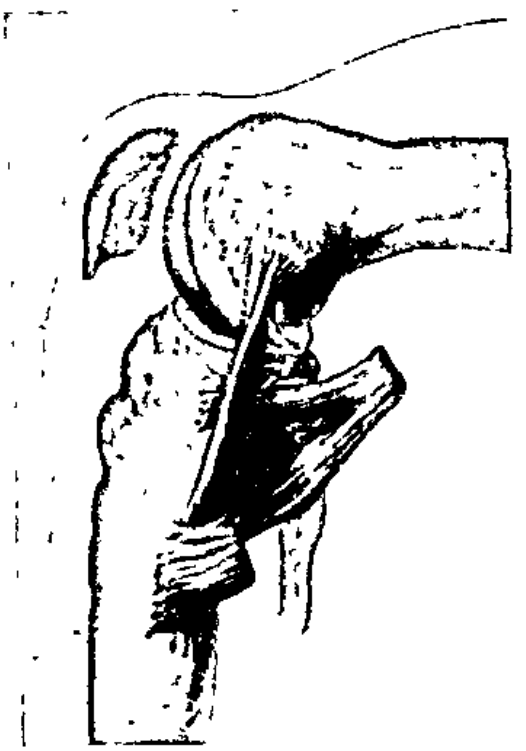

FIG 359.—The tibial collateral ligament in flexion of the knee
(Abbott et al J Bone & Joint Surg., Vol 26)

However, in our contribution to this clinic the writers envision their particular challenge to be to point out the application of another factor which is building for maximum achievement in knee joint surgery for internal derangements, namely, preoperative diagnosis—the estimate of the situation which will lead to the most intelligent surgical planning as to operative approach and management of the deranging factor or factors

Not so very long ago it was a custom to speak of this type of joint trouble of the knee as a "Pandora's box" You opened it and were prone to be not only surprised but disconcerted by what it revealed, or seemed to It was probably a period not much more removed in time that something similar tended to prevail as to abdominal operations—a time when exploratory laparotomy was the most frequently seen listing on surgical schedules Today an approach such as might be connoted by the term "exploratory arthrotomy" should carry the same implications But the analogy differs in that closely accurate preoperative diagnosis in knee joint work stems to a very small degree from extensive clinical aids, but in the main from anatomical, pathological and physiological knowledge associated with the diagnostic acumen attained by experience and thorough analysis of symptoms and physical findings

ANATOMY OF KNEE JOINT

Let us proceed, then, first with a quick glance at the anatomical structures with which we are dealing[1] (Figs 358-361) First visualize the knee not as a true hinged joint, but one in which the tibial tuberosities glide in an arc of over ninety degrees around the axis of the femoral condyles Next we must appreciate that the intrinsic ligamentous apparatus, namely the posterior capsular ligament, the mesial collateral (tibial), the lateral collateral (fibular) and the two cruciates are structures each of which are taut only in certain phases of joint action As a result this joint has flexibility not only in flexion and extension, but also in certain postures toward some side play and considerable torsional rotation. We must note in the latter connection that a pivot joint is provided through the socket formed by the thick high-rimmed and nearly circular lateral meniscus, which is quite securely tethered to the tibial plateau, while a greater gliding space is provided by the more semilunar shaped mesial meniscus, which in turn is more mobile on the tibial plateau.

Note also that this mesial meniscus, unlike its fellow, is rather intimately attached to the posterior Y branch of the tibial ligament so that it may slide backward a little with the tibia as it glides back around the greater arc of the mesial femoral condyle. This mesial meniscus is seen to be narrow anteriorly but wide posteriorly; and when both flexion and

axis as the curve of this cartilage. We can see that a split at this point, before it has progressively extended forward, cannot be visualized by an operative approach that is not based on the consistent physical signs obtainable.

While there are a great many anatomical considerations of importance one more only will be touched upon. This is the articular surface of the patella, which is shaped similarly to the hull of a boat, and, like a boat being launched, travels along the "ways" of the trochelear trough of the femoral condyles. As the name trochlea implies, the mechanism is more that of a pulley over which, like a rope, the rectus femoris muscle pulls upon the tibia, the patella being a sesamoid bone in its tendinous course. When weight is taken on the half-bent knee, by this mechanism the pressure between the contacting articular surfaces of patella and trochlea is many times more than sustained by any other articular surface of the joint. But when any surface irregularity of cartilage prevails at this site frictional resistance becomes great, even comparable to the grip of tire corrugations on pavement. We have also compared this effect to that of a splice in a hawser when running through a narrow chock. The potential clinical significance of this will be discussed later.

PHYSIOLOGY OF KNEE JOINT

There are a few points of physiological and pathologic nature having potent significance in mechanical disorders of the knee. In the first place ligaments, while basically of connective tissue structure, also contain elastic fibers Hence when complete disruption occurs in an isolated ligament, retraction beyond capacity for spontaneous bridging will occur. The fibular and the cruciate ligaments are of such a type. On the other hand a transition of fibrous repair tissue to the connective tissue substance of a ligament does favor spontaneous reconstitution, and for such ligaments as the posterior and the tibial, which are reinforcements in the total ligamentous capsule, adequate spontaneous repair can be envisioned save when the damage is a total avulsion or a diffuse transverse rent. These considerations guide the surgeon in choosing between immediate surgical repair and graduated mechanical support. Also equally important is the knowledge of the physiological and anatomic interplay of certain ligaments with others in intrinsic stability, making for instance for much greater residual instability from loss of the posterior than of the anterior cruciate ligament.

In such a consideration we must understand that hyaline cartilage has extremely limited capacity for repair (Bauer and associates), decreasing in adult life and when subject to functional trauma practically to nil. Also, the surface cellular substance, once it has been [illegible]

possible pathologic conditions which can be encountered rather than just the one or two most frequently met. Excluding the mechanical effects of residuals of fractures of tibia or femur extending into the joint, the accompanying outline (Table 1) lists this group of lesions roughly in the order of frequency with which they are likely to be encountered.

TABLE 3

METHODS OF DIAGNOSIS

1 History
- Major and minor symptoms
- Duration
- Manner of onset
- Source and conditions favoring recurrences

2 Inspection:
- Gait
- Posture of joint walking and standing
- Outlines of limb as a whole, of joint, of thigh
- Thigh measurements

3 Palpation
- General feeling in the periarticular region
- Consistency of tissues
- Surface temperature
- Estimate of fluid content of joint through wave or floating of patella
- Points of pressure tenderness

4 Mobility
- Restriction—protective or mechanical
- Degree
- Relationship to fluid content

5 Manipulation Tests
- Patella noise
  - Under ordinary active extension
  - Under resisted active extension
  - On manual movement of patella
- Side rocking
  - In full extension
  - In slight flexion, side stresses
- Tibial torsion on femur
  - At right angle flexion
  - In acute flexion (Watson-Jones sign)
- Anteroposterior laxity (Drawer sign)

Many of these lesions will have certain symptoms in common, and a few will have certain findings in common, but in the main, each will have a certain combination of specific points both subjective and objective that are pathognomonic. This is not always true as to the pathologic etiology, but almost invariably true as to the anatomic structure involved

With practice an evaluation can be made as to the indications for treatment, and, if surgical, as to the best operative approach and definitive measure. Such a careful preliminary approach in each specific case also brings about a warning as to the possible multiplicity of lesions in a single joint, something not infrequently encountered. For example one or more of the following are quite often found present: lateral and mesial meniscus lesions, ligamentous damage, loose bodies, hypertrophied villous tabs and, most frequently of all as a concomitant, lesions of the patellar cartilage. All too often we meet instances where either a negative arthrotomy had resulted from failure to appreciate a

TABLE 4

X-RAY AIDS IN DIAGNOSIS

1	Diagnostic:
	Osteochondritis dissecans
	Calcium-containing joint mouse
	Fracture of tibial eminence
	Osteochondromatosis
2	Helpful
	For meniscus damage
	Comparative study of joint space
	The Reynolds Abduction study
	Aerography
3	Negative.
	Patellar chondropathy
	Meniscus with small tear
	Discoid cartilage
	Villous tabs
	Ligamentous laxity—unless by stretch study

possible differential, or where a concomitant lesion, equally disturbing of function, had been overlooked.

Since x-ray is dependable in diagnosis in only a minority of internal derangement lesions, the history and physical tests have an importance that cannot be too greatly emphasized. Tables 2, 3 and 4 are suggestive of the basis of approach in these respects. But adequately dependable information can usually obtain only from most patient and thorough questioning, and from detailed and systematic physical examination.

ILLUSTRATIVE CASE HISTORIES

The following cases in point are illustrative of situations of combined lesions.

CASE I.—Mrs. M. A., a 50 year old business woman, began to have momentary

locking and giving way of the right knee about three years before being seen by us About a year and a half later the joint abruptly locked against the last 35 degrees of extension Motion otherwise was retained This restriction of extension was never overcome, and all walking since had been in this position Advice obtained at that time was of possible relief surgically, but a probability of a residual stiff joint In more recent months a further disability developed of constant instability on stairs and frequently on normal walking, with episodes of puffing of the joint Physical examination showed restriction as described, resistance to manipulations, but lacking the diagnostic signs of meniscus pathology In addition there was an audibly coarse crepitation, also transmitted best through the patella, on any active extension function through the range permitted plus pain on patellar pressure

Comment —(1) The range of extension limitation was greater than that which could be accounted for by disease of the meniscus, and indicated the probable impaction in the intercondylar notch of a large loose body, such as derived through the sequestration of a lesion of osteochondritis dissecans in a femoral condyle. (2) The secondarily developing instability combined with the crepitation and tenderness pointed to a degenerative lesion of the patellar cartilage, to which a woman of her age, walking on a partly flexed knee, would be particularly susceptible Confirmation of the first supposition was obtained from x-rays. Surgery was advised and planned to include patellectomy. At operation not only was there practically nothing left of the cartilaginous covering of the patella, but on the opposing surface of the femoral trochlea most of the chondral covering had been deeply abraded. A patellectomy was done After picking the large joint mouse out of the notch two thirds of the extension restriction disappeared, the remaining third coming only after breaking up adhesions in the posterior cul-de-sac and stretching out contractures in the posterior capsular ligament The eventual relief of disability was at the expense of protracted after-care that could have been obviated by early recognition of the indications and predictable ensuing complications of neglect.

Case II —Mr C L, a 45 year old business man without injury other than a severe blow on the knee cap in youth, developed gradually increasing instability in the left knee After some months a sensation developed on rising or on stepping up or down This was described as feeling like rubbing on a scrubbing board He consulted a surgeon who diagnosed and removed what was reported as a loose mesial meniscus However his symptoms remained unchanged and he was told that he had a neurosis About six months later he consulted us, and was truly introspective about his knee, but by this time he was showing a large effusion which he had been advised was rheumatic Removal by aspiration of the effusion revealed a coarsely grating patella—and the answer to his difficulties Operative

exposure showed the surface layers of patellar cartilage in shreds. The condition was treated by scalpel shaving down to a viable layer. This man on treatment for an ankle sprain some ten years later reported continued complete freedom from any symptoms in this knee, and the joint exhibited completely normal function.

CASE III.—Mr. A. B., 55 years of age, gave a history of a twisting injury followed by swelling, lateral pain and incomplete extension. The condition gradually ameliorated, though for many months there was intermittent locking. This ultimately disappeared also, but there supervened pain and discomfort on rising or stepping up and down, and what he described as a new feeling of instability and giving way. Shortly before being seen a fall had resulted in constant residual pain at the inner side of the joint. The findings at examination were pain on side rocking and on torsion, side laxity, mesial joint line tenderness and patellar grating. A diagnosis was made of patellar chondrosis plus single or dual meniscal lesions, and at operation the approach was for a radical arthrotomy. By reason of the advanced degeneration found the patella was removed. Further investigation revealed an early lesion of the mesial meniscus, and a full length axial split of the lateral one, this being looped "bucket-handle" into the notch space. And after bilateral meniscectomy plus the patellectomy this triple-lesion knee attained 90 degree motion in a couple of weeks and full functional competence in two months.

CASE IV.—Mrs. M. F., a 45 year old housewife, had been afflicted by recurrent displacements of the right patella all her life. Usually these were momentary subluxations; occasionally the patella would lock off at the side until pushed back in place. Pain would be severe or sickening and though the effects had been fleeting or transient, her fear of any physical activity had become extreme. Medical advice from various sources had stated that no practicable cure was possible. She related that a few weeks before being seen by us a more severe episode than usual had occurred, with a new and tearing sensation, and for the first time swelling occurred, with continuing pain on function, and almost complete disability. Apprehensive protection prevented obtaining almost any evidence from examination save the presence of slight effusion and of sharp pain on patella pressure.

Comment.—(1) By a variety of sound technics recurrent dislocation of the patella is surgically curable; these technics are generally extra-articular, not entering the synovial compartment. Save in children, however, the writers are against avoiding arthrotomy in such technics, for reasons to be indicated. (2) A person of the age of this patient with such a chronic history can be assumed to have acquired sufficient deterioration of patellar cartilages as to indicate the probability of an ultimate disability from such pathology irrespective of the cure of recurrent dislocation, which should contraindicate surgical measures which included preservation of this sesamoid bone. (3) As a deduction from the

which one of us either performed or directed the arthrotomy, the incidence was about twenty per cent. A high majority of the cases, with numerous medical examinations, had arrived on the service undiagnosed despite an adequate basis for it, and many had had unsuccessful operations with erroneous diagnosis

This then might be looked upon as the incidence rate for young men exposed to occupational or recreational hazards to the knee joint. On the other hand it may surprise you to know that in a general civilian orthopedic practice covering all age periods and activities we have found this lesion to have a higher incidence in our recognition than any other internal derangement of function, and it is approaching first place in our indications for arthrotomy.

Pathology.—From the accumulation of observations over the last decade, we have become entirely satisfied that these lesions of the patellar cartilage are subdivisible as to pathological character into three separate forms as denoted in Table 5

TABLE 5

PATHOLOGICAL TYPES AND ETIOLOGY

1	Chondromalacia—congenitally imperfect cellular differentiation Clinical incidence decades 2 and 3
2	Chondritis, posttraumatic—spreading fissures or lacerations Incidence decades 3 and 4 principally
3	Chondrosis, presenescent—selective cartilaginous degeneration Incidence decades 4 and subsequent

To the first—and least frequent—the term chondromalacia we believe most properly applies. It is of congenital origin, with symptoms manifest sometimes as early as the second decade, and usually mistaken for rheumatic disease The process is not a localized one but involves the entire structure of the cartilage of the patella Grossly the entire surface will be lacking in normal hardness, but will be "plushy" instead, indenting or even wrinkling on pressure Instead of a pearly white opalescence, the color has a bluish tinge. The surface is uneven or undulating and to varying extent there will be irregular areas of ragged fragmentation and loss of substance, some constituting the entire thickness down to underlying bone. Microscopically, the cell structure everywhere is that of imperfect differentiation to mature hyaline cartilage and consequent attritional degeneration, edema and fibrillation

Type 2, strikingly different, constitutes the residuals and consequences of a localized traumatic fracture or laceration at one point on the articular surface; elsewhere the surface is normal in appearance both in color

and consistency. With hyaline cartilage having no power whatever of healing or repair, the laceration not only persists but under the attritional trauma of friction and compression the defect gradually enlarges through fibrillary degeneration into widening fissures, fringes and even flaps, sometimes though not often reaching the depth of the underlying bone.

Type 3 represents localized premature senescence of hyaline cartilage cell structure, to which that of the patella is peculiarly susceptible, and might properly be termed degenerative patellar chondrosis, for it usually is an isolated manifestation in the particular joint for a long period after its inception. Though often to some degree bilateral, it will be the only manifestation for many years of presenescent arthrosis in the whole skeletal system. While such cases are commonly diagnosed as arthritis, from the angles of approach and treatment this would be a clinical misconception.

In this lesion the cartilage has a yellowish hue over its entire area, which also will show replacement of more or less of its glassily smooth

TABLE 6

MECHANISM OF ACUTE TRAUMA TO PATELLAR CARTILAGE

1	Blow on front of knee when semiflexed in weight-bearing
2	Fall on face of flexed knee
3	Acute or recurrent dislocation of patella
4	Disruption from fractures of this bone

glistening surface by a finely or coarsely granular one, with smaller areas of fissuring and fragmentation, and often a ragged defect in full depth. Microscopically, the picture is one of generalized fibrillar degeneration and necrosis on which laceration or breakdown is superimposed.

Therefore, these three pathological types deserve individual consideration from angles of prognosis and especially of treatment, as will appear below.

Mechanism of Trauma.—Since purely traumatic lesions have a high incidence, a glance at the mechanism of their production may be worth while. In relation to the items listed in Table 6, we believe a corollary prevails as to the logic of a therapeutic position which we have for some time maintained that any reconstructive procedure for recurrent dislocation of the patella should include an arthrotomy and inspection of this structure, and that, save in children, the best solution eventually of this disability in most cases is patellectomy.

Observations of late complications of patellar fractures, even clean

transverse ones with apparent anatomical reduction and union, points to more consideration of the excellent functional results obtained by treating this injury primarily as well as secondarily by patellectomy.

Symptomatology.—The subjective symptoms of lesions of the patellar cartilage as listed in Table 7 are often so completely pathognomonic as to be diagnostic of the existence of the condition. It is true, however, that they are not always obtained without careful history taking on these specific six points, and it is true that some, but not all of them, obtain in other causes of internal derangement Recognition by the patient of palpable or audible grinding on function, plus pain on direct pressure on the patella, occurs only in the lesion discussed.

Physical Signs.—Next of course in diagnosis comes "physical signs," which as shown are few but absolutely diagnostic To obtain the crepita-

TABLE 7

SYMPTOMS AND SIGNS

Subjective Symptoms
Sensation of scraping and crackling, sometimes audible
Insecurity and weakness
"Giving way," often with unaccountable falling
Stiffness and soreness when getting up onto feet
Pain on kneeling, or on other pressure on kneecap
Intermittent hydrops (after stair climbing)
Physical Signs
Crepitation, audible or palpable, transmitted through patella during resisted quadriceps action
Clicking or grinding when patella is moved by hand
Pain on direct pressure or manual movement of patella

tion by the manual test, it is necessary to have the limb in supported full extension at the knee and to get complete quadriceps relaxation, which we find most easily obtained by rolling the limb in and out for a moment. While not specific, of course, an increase in joint fluid may prevail with this lesion The physical examination should be course proceed step by step to complete anatomical and functional testing, and the diagnosis gains some support through exclusion of other lesions through both physical and x-ray examinations. Incidentally, this lesion is not demonstrable by x-ray, and logically so. It also can well be mentioned that more than one form of internal derangement with functional effects may prevail in any knee, and too frequently are arthrotomies carried out on one confirmed diagnosis, and another lesion left unsuspected to compromise the result.

Complications.— As having some bearing on treatment of election the complications and sequelae of lesions of the patellar cartilage, as listed in Table 8, might first warrant consideration. Quadriceps atrophy and weakness are an inescapable articular neuromuscular reflex response. So with the knee joint intrinsically weak and unstable and dependent to a major degree on this external muscular support, persistent and progressive quadriceps weakness leads to laxity and consequent joint deterioration, as well as to susceptibility to other traumatic derangement lesions.

TABLE 8

COMPLICATIONS OF PATELLAR LESIONS

Quadriceps atrophy and progressive weakness
Chronic sympathetic generalized synovitis
Joint laxity and secondary degenerative arthrosis
Loose bodies from detached fragments of patellar cartilage
Traumatic secondary attritional erosion of opposing trochlear articular surface

TABLE 9

THERAPY OF PATELLAR CARTILAGE LESIONS

A. Palliative:
Restricted activity of stair-climbing, running, kneeling and similar motions
Complete nonfunctioning joint rest in phases of generalized joint reaction
B. Surgical. Procedure according to age and type lesion:
1. Chondromalacia (congenital)
Resurfacing by scalpel shaving *entire* surface
2. Traumatic chondritis
Shave of entire involved facet (in earlier life)
Patellectomy (in later life, or after fracture)
3 Presenescent chondrosis
Patellectomy

It must also be realized that when the entire body weight, as in stair-climbing or running, is taken on a knee maintained at semiflexion by the resistance of the quadriceps, the pressure at the articular surface of the patella is extremely great. Under such conditions the sliding of a deeply abraded patellar cartilage surface can easily bring about scoring or abrasion of the contacting articular cartilage of the femoral condyle, and at the very point where it should smoothly glide on the anterior horn of the meniscus when the knee is extended Loosening or detachment of the latter by this mechanism has been found as a secondary complication.

Therapy.—The important comment on Table 9 should be that non-

surgical therapy at best can be but palliative, and confined in influence to the subjective effects and to the amelioration of them. If any reason on *other counts prevails for deferment of surgery*, under such a regimen surgery can often be postponed without much risk for months or years if the condition is recognized at an early stage.

However, with pathologic changes well advanced whatever their type and etiology, surgical intervention alone can eliminate disability, restore full function and obviate unfortunate and irreversible sequelae.

The prevailing pathologic type demands discrimination in the choice of the operative attack. Taking the order of the three types in reverse no confidence can be maintained as to the functionally efficient survival of any part of the cartilaginous structure of the patella in well-established presenescent chondrosis; and in middle life or beyond the relatively susceptible surface of the femoral condyles should be protected against the friction of even a well-smoothed-down patellar surface Since function is unimpaired by the loss of this bone, patellectomy is the only type of intervention to be considered. As to technic, the important point in the operation is synovial reapproximation, either vertically or from side to side before the aponeurotic and capsular approximation is done

In the after-care of this procedure early motion is of course not feasible, and is begun very gradually after the first ten days At the end of another ten days the range of flexion will usually have progressed to not much more than 45 degrees and will have become arrested there At this stage, under a brief relaxing anesthetic, motion to 90 degrees with release of fine adhesions under the suture line will occur through only the most gentle manipulations, and from then on active use with progressive functional improvement can be counted on At this stage resisted quadriceps re-education, the *sine qua non* of the convalescent management of any knee arthrotomy, must be conscientiously adhered to

For operative indications it might be held that the same logic applies to congenital chondromalacia. But there is this difference. In the second and third decades there is considerable reparative capacity in the deepest chondral layer of this tissue, which has a good blood supply and capacity for fibrocartilaginous proliferation from the underlying bone. Secondly, at this phase of life and activities the buffering protection of the patella against traumatic insults to the femoral condyles (which seems to be the only useful function of this sesamoid bone) would seem desirable to retain. As to technic, however, the nature of the basic pathology clearly indicates, in conservative treatment of the lesion, a very careful and meticulous scalpel shaving of the entire patellar surface down to the basal cell layer A localized curettage of the major defect will fail to relieve the existing symptoms as well as to forestall the inevitable progres-

sive breakdown of the less grossly involved areas. While the result is not an absolutely quiet knee, it is symptomatically greatly improved and will so continue, at least in our experience, for many years.

Finally, when traumatic lesions are residuals of patellar fractures, or complications of recurrent dislocation in adults, excision of the patella again is the choice to be made. But otherwise in the great majority we have found a lesser extent of intervention to be satisfactory and, we believe, more advisable.

In the first place, such injuries are prone to occur in the physically and recreationally active phases of life, with the applicability of the argument for retention of this bone In the second place, the lesion is a single and circumscribed one, confined to one facet of the articular surface, almost always the mesial one; except when of very long standing it will not have penetrated to the full depth of the articular cartilage. But here again we want to oppose the idea or practice of simply curetting the ragged defect. The mechanics of functional movement of this articulating surface are such that it must be smooth and level or it will have the action of a tire tread against sliding on the pavement, and the defect will persist in its symptoms and will by marginal attrition extend at its margins. The logical treatment to our minds, as well as on the basis of results, is a uniform shaving down of the entire involved facet to the depth of deepest penetration of the traumatic defect.

Summary.—Lesions of the cartilage of the patella have a high incidence among the mechanical causes of disturbed or disabled function of the knee joint. Allowed to persist, they produce secondary progressive deteriorative and irreversible effects The lesions are separable into three pathological and etiological types, and the differential discriminative surgical treatment of each is, with intelligent technic and after-care, highly successful in its results.

OPERATIVE TECHNICS

Before concluding this review it is indicated to devote some space to a consideration of the technical angles of surgical intervention In the first place there can be little doubt that the basis for confidence in the outcome of such interventions rests to a considerable degree on the conscientious application of refinements of general basic surgical technics. The first is scrupulous aspetic surgery, including skin cleansing, walling off from the incisional field of all exposed skin, and instrumental technic. The second is avoidance of tissue trauma by gentleness of manipulation and instrumentation, with tools designed for the intended purposes.

Next for emphasis would be thorough hemostasis In accomplishing this it is our feeling that electrocoagulation is probably preferable to

the finest ligature material. In this aspect, although anatomical recognition and operative experience usually permits the securing, before division, of most major points of bleeding, diffuse minor ones that can be controlled in the closing suture line will prior thereto allow escape of blood into the joint, with consequent obscurity of the field and traumatizing intra-articular sponging. Therefore most experienced operators favor the relatively ischemic field obtainable by elevation and tourniquet application. However, even with the precaution of heavy padding, an elastic constriction should be avoided in favor of a pneumatic one. The latter, aside from eliminating most chances of tourniquet paralysis, causes no muscular discomfort or inhibition postoperatively.

In such a field the tissue structures are well defined. Potential and obvious bleeding points can or should be completely controlled. All intra-articular sponging can then be eliminated in favor of a suction instrument. Such technic, followed by a comfortable elastic compression dressing, has been so effective that the authors find it difficult to recall an instance wherein a postoperative effusion or hemarthrosis required aspiration or was a notable incident.

The criterion of surgical achievement in interventions today for this group of disorders is not only a mobile and functioning joint but also one which remains free from minor disturbing dysfunction. In this connection we believe that incisional approaches based on an accurate preoperative estimate of the situation are of major importance Basically the approaches must be delimited by regards for preservation of integrity of various elements in the capsular structures. There are opportunities for the exercise of considerable judgment in the election of the procedure most desirable in the presenting situation.

To a few specific tenets we are strongly adherent. One is the condemnation of "button-hole" approaches. Such we believe carry no consequent benefits and are commonly responsible for avoidable intra-articular trauma. They prevent adequate management of revealed disease, and exclude as well the recognition of some preoperatively indeterminable lesions. Instances illustrative of the latter are posterior third meniscus splits and early stage lesions of the patellar cartilage. Another tenet having bearing on approaches is one gaining progressively strong support today, namely that no portion of a damaged meniscus can in the long run of cases be safely left in situ. The approach must be one in such a lesion which will permit a total anatomical meniscectomy.

Therefore in specific application of our theory the most commonly indicated arthrotomy should have an anterior parapatellar limb sufficiently proximal to allow, when the joint is in maximum extension, capsular elevation and retraction to permit good visual and instrumental

investigation of the articular cartilage of the patella in the first instance, whatever the preoperative diagnosis has been. Now through such a relatively anterior arthrotomy, and also through the more common anteromesial (or lateral) one, it is only in the relaxed and hypermobile joint that a total meniscectomy can be carried out. Hence increasing favor has been gained by a technic in which a second penetration is

FIG 362.—The outlined skin incision for approach to the mesial meniscus is seen to begin close to the mesial border of the patella and is deflected mesially on the tibia after crossing the joint line which is indicated by the short horizontal marking.

made through the capsule posterior to the tibial (mesial-collateral) ligament—at the site of approach for loose body in the posterior cul-de-sac—through which the posterior third of the meniscus is dissected free. For meniscus approach alone a retractable single skin incision (Patterson) will suffice for both capsulotomies.

However, for many years it has been our custom, stemming from concern over the incidence of patellar cartilage lesions, to utilize a new (and

unpublished) approach of a somewhat novel character on the occasion of any meniscus attack (Figs. 362–368) It might be termed "capsular and subperiosteal." For the mesial meniscus, for example, the skin incision starts close to the mesial border of the patella at its midpoint, extends vertically downward to the level of the joint line, swinging for

FIG 363 —The fibrous capsule has been divided following the outlined skin incision The joint line is seen at the inferior margin of the retractor on the left From this point the deep incision divides for reflection of the capsular insertion and periosteum from the front and mesial aspect of the tibial tuberosity, as far as the insertion of the tibial ligament

This and the diagrammatic photographs which follow were made with dissection of a fresh anatomical specimen)

another few inches mesially and distally. The quadriceps fascia is divided continuously along this same line Proximally to the joint line capsule and synovial membrane are incised, entering the joint cavity. Distally to the joint line the incision is deepened to the tibial bone surface in a diagonally mesial direction as far as the anterior edge of the

tendinous pes anserinus. At this distal and mesial point it will have diagonally divided also the more anterior fibers of the tibial ligament along the thin bony insertion. Working upward and mesially to the joint line beneath the meniscus, a sharp periosteal elevation is made of the capsular insertion on this anteromesial face of the tibia.

FIG 364.—Fibrous capsule has been reflected subperiosteally and meniscus exposed. Note capacity to visualize a posterior split, often not revealed in usual approaches

With a severance of the coronary fibers attaching to the meniscus, a surprising amount of release occurs of the tension against mesial retraction, and two thirds of the meniscus is at once freely exposed. In the conventional position in which the leg hangs vertical with 90 degrees joint flexion, the seated operator then produces outward torsion and abduction with his knees or an assistant's hand. On this maneuver the entire posterior third of the meniscus not only comes into plain view but with so much interosseous space available that straight knife and scissor

dissection liberates this portion of the meniscus in a precise anatomical fashion, with no trauma either to adjacent bone cartilage or to synovial membrane.

On extension of the joint the periosteal and fascial flap falls back into place where its incisional line is resutured, and reunion to bone rapidly follows, with no consequent joint laxity This technic has been consist-

FIG 385.—Meniscus elevated and dissection proceeding under direct vision with mobilization from tibia

ently most satisfying, not only in the delivery in toto of the entire meniscus with its extant pathology, but in the frequency with which there has appeared at initial inspection a meniscus entirely normal in its visible anterior half, but at the second stage of the exposure an otherwise fully concealed split in the posterior half.

It is desired to mention one other incisional approach item. At arthrotomy for lesions of the patellar cartilage it is usually possible as well as

desirable to have determined, on the basis of physical findings or age of patient, whether the operation will be a resurfacing one or a patellectomy. The consequent incisional scar should best not directly overlie a bony prominence. If the former procedure is indicated, the incision should be a patellar skirting one; but in the case of the latter it should be midline anterior. In such event the scar will lie over the hollow trough of the femoral trochlea, and in either instance will obviate kneeling discomfort.

FIG 366.—Meniscus displaced into intracondylar space after mobilization as far as posterior attachment, which is divided through the notch.

POSTOPERATIVE REGIMEN

This discussion should not close without a few words about after-care in operations done for the disorders producing internal derangement of knee joint function. In this connection the authors would like to stress at the outset a possibly uncommon clinical attitude. On the one hand, both in management measures and patient's interest no direct stress

whatever is placed upon joint motion; on the other hand, all the emphasis is placed on capacity for active achievement of the fully extended position of the joint and upon quadriceps re-education to full power

We will have had initially a joint devoid of any factor interfering with mobility save for the mechanical one, which we have by operation eliminated With good surgery we will have introduced no factor interfering with motion save for the pain inherent in incised tissues during the initial

FIG 367.—Meniscus removed Posterior capsule and cruciates are readily visualized

healing phase If we allow such pain to be stirred up in the initial regimen, there will obtain first a psychological continuing block against mobility through protective spasm, and as a consequence there will be muscle atrophy and consequent painful instability.

One fairly certain way to produce a postoperative effusion is to push motion that must be inescapably painful when the surgically traumatized tissues are still sensitive. The effusion produces reflex quadriceps atrophy and further painful instability, the habit of weight

bearing without full extension develops, and through this factor postural strain completes the vicious cycle and a tedious convalescence and prolonged dysfunction is very likely to follow. Contrariwise, adherence to the sound physiological principles of joint function will reverse such course of events.

Accordingly the natural idea of initial joint rest is explained to the patient who is also advised that progressive mobility is bound to ensue

Fig. 868.—Procedure completed. Closure in anatomical layers readily accomplished as deep layers oppose without tension.

whenever the joint is ready for it. There need be no hurry, and only as the part is comfortable does motion have to proceed. Experience has thoroughly corroborated this psychological and physiological approach.

On the other hand, the seed of the idea of the need of strength of control is planted at the outset, and it uniformly finds fertile soil. Our initial regimen then is a comfortable elastic compression dressing and a long posterior ("ham or back knee") splint such as can be contrived from Yucca board In such, weight-bearing—a purely bony function—has

no contraindications at any moment after operation and may not be particularly uncomfortable from the outset.

On the very first postoperative day hip function is introduced. The start is made by assisted straight leg raising and by just adding active control of the return lowering, the whole exercise quickly becomes entirely active by the patient. Thus, the action of the football "punter," is carried out with progressive frequency daily, and in a few days proves effective against resistance in excess of the limb's own weight Recalling that the quadriceps femoris in its rectus portion is a biarticular muscle, it becomes apparent that re-education and strengthening are thereby obtained in this exercise As the patient's interest and confidence increases, the need for the protective support of the splint no longer appears apparent, and it is removed on the condition that the same exercise, with knee actively maintained in extension, be adhered to. In some individuals this may be achieved as early as the third day; in others it may be later, but is insisted on even if it takes a week to achieve. Whenever it is arrived at, the patient is instructed to "limber up" at will, and walking is encouraged provided full active extension on weight bearing is adhered to and extension exercises are kept up.

Under this regimen the average male will be ready to leave the hospital in a week or less—women usually will take a little longer—after operation for most types of internal derangement. As much supervision as necessary follows in the quadriceps re-education program, in which muscle massage is of some additional value. Weight-lifting in extension in progressive amounts is soon added to the program, and quadriceps redevelopment is kept track of by measurements Always the range of flexion motion is left to the patient, and always its progress is more rapidly effected by quadriceps function than by direct efforts at flexion. In general a 90 degree range obtains in a couple of weeks after inception; the remainder comes somewhat more slowly. Stability is insured from the outset in this regimen The total morbidity will be from four to six weeks, depending on the occupation

In the postoperative care after patellectomy, the above regimen has to be somewhat modified, and the details of the change are affected by the factor of the particular repair technic required. When a capsule relaxed from effusions or other factors permits side-to-side approximation at the patella defect there is minimal strain from either flexion or quadriceps "setting" on the deep suture line, but a full week of splinting in extension is necessary, assisted motion, usually by counterpoised suspension, is the program for the second week. Whenever in the surgical repair vertical approximation has been required, somewhat more delayed mobilization is necessary while the consolidation of the extensor

apparatus is taking place. In this type of case, and also as a rule where secondary erosion of the femoral trochlea has been found to prevail, some fine adhesions will have had opportunity to occur under this deep suture line. The result usually is that the flexion range reaches only 35 to 45 degrees in the first few weeks and remains checked at that point Accordingly a brief analgesia such as sodium pentothal is given to permit lysis of these adhesions, which will give way from no more force than the weight of the lower leg itself and allow an immediate 90 degree range, and from then on the regimen is as usual.

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CONSIDERATIONS OF DIAGNOSIS, SURGICAL TREATMENT AND AFTER-CARE OF BREAST CANCER

ARTHUR B. MCGRAW, M.D., F.A.C.S.

AMONG surgical procedures currently accepted as adequately radical for the cure of cancer in its more common forms, the operation of radical mastectomy is unique in having needed no essential revision of its rationale or technical requirements since its first description fifty-eight years ago.* For thirty-two of those years members of the staff of this clinic, in common with a host of surgeons the world over, have consistently endeavored to perform the operation to the full limits of that description. Year after year, however, we have been consulted and continue to be consulted for the relief of rapid recurrence by individuals whose allegedly radical mastectomies were no better than caricatures of a truly thorough operation.

In the paragraphs that follow, there have been sifted from a good many years of close association with and reflection upon this operation and its results certain attitudes towards diagnosis that seem most significant for making radical mastectomy a hopeful operation to undertake, certain conclusions regarding the sequence and methods of technical procedure most likely to achieve the purpose of the operation, and certain concepts of immediate and late after-care to which we believe the operating surgeon is obligated. This plan of presentation has the dual aim of containing enough reasoned argument to dissuade some of the few who reprehensibly continue to allow mere surgical lip service to masquerade as fidelity and competence, and enough useful ideas to interest the many who, like ourselves, have found radical mastectomy an operation which continually challenges yet too often eludes completely perfect accomplishment.

DIAGNOSIS

The Importance of Detection by the Patient.—A physician's chances for treating a breast cancer with good prospects for cure depend most of all upon the invasive vigor of that particular tumor and upon how much opportunity there has been for the development of metastases. Growth

From The Henry Ford Hospital, Detroit, Michigan.

* William S. Halsted's first description of the operation that bears his name was published in the Johns Hopkins Hospital Reports, Baltimore, 1890–91, 2:255–314 as Part IV of an article entitled, "The Treatment of Wounds, with Especial Reference to the Value of the Blood Clot in the Management of Dead Spaces."

characteristics are beyond our power to alter but wealth or meagerness of opportunity to metastasize is always conditioned by three controllable time factors, namely, how long the tumor has been in the breast before the patient noticed it; how long the patient has known of the condition before consulting the doctor, and how much time has elapsed between consultation and adequate treatment

Taking these factors in reverse order, delay beyond a few days in instituting radical treatment is seldom obligatory, even in the present overcrowded state of most hospitals The country-wide campaign of lay and professional cancer education of the past two decades and especially of the last few years has without question increased the promptness with which most women submit breast tumors to examination and the promptness with which most surgeons recommend treatment. So great has been the emphasis, however, upon promptness in reporting a growth and promptness in therapy, that consideration of the very important *initial* period of time a breast tumor has existed before detection has been relatively neglected In our experience the great majority of women discover breast tumors by pure chance, thus making the previous duration entirely conjectural Our conjectures have so often been turned by circumstantial evidence in the direction of long rather than short duration that we have come to believe very strongly in self-examination of the breasts, and to advocate that such examination be made at regular intervals Daily examination is obviously too likely to breed neurotic fixations and besides will make the breasts tender Examination just before and during menstruation is apt to be misleading Therefore, for practical purposes, we favor careful but very gentle self-examination of the breasts once a month, between menstrual periods Before the practice is adopted, a physician should be consulted and the breasts pronounced free of palpable masses and their texture within normal limits Furthermore, women should be strictly instructed to seek and report only clear-cut deviations from earlier examinations It should be made clear that the sole purpose of self-examination is *detection*, not diagnosis If the above suggestions are followed, we do not believe there need be fear of neurotic fixation We do believe that only by such regular examinations can the tragedy be avoided of an intelligent woman conscientiously reporting without delay a breast tumor of obviously long duration which she "just happened to notice " There will also be avoided the instances in which women relate the development and cause of breast tumors to one or more irrelevant traumatic incidents and delay seeking advice.

Adequacy and Precautions in Clinical Examination.—After trying most, if not all, of various ingenious devices and methods that have been

suggested to aid the clinical examination of breast tumors, we have come to content ourselves with careful inspection, palpation and occasionally transillumination. Furthermore, we believe that these two indispensable procedures are much more important for securing and recording accurate topographical information than for exact differential diagnosis.

Inspection requires full, simultaneous exposure of the breasts, both in the sitting and recumbent position. It is useful chiefly for observation and comparison of general characteristics such as size, position, symmetry, bulk and type of nipple. No other part of the female body surface has wider variations in the same individual at various ages or between different individuals of equal age. Any breast tumor large enough to be seen can be better palpated, but sharp observation will sometimes reveal, even without aid of manipulation, very early slight skin retraction from a scirrhous growth beneath.

Palpation should follow inspection and yields more significant information. Its essentials are methodical thoroughness, with complete exposure of the breast, arm and axilla, and *extreme gentleness,* especially in the presence of a palpable mass If a patient is sure she has something abnormal in her breast, she is asked to indicate its location and the mass is examined before any other part of the breast is palpated. By so doing, signs obviously suggestive of cancer will be detected at once and extra caution used throughout the rest of the examination. Otherwise, each breast is first palpated as a whole and then each quadrant in succession. Variations in the relative proportions of glandular, fibroconnective and fatty elements are almost as wide as those of size and shape already mentioned. We are opposed to squeezing the breast or nipple unless a watery or bloody discharge is complained of. If such is the complaint, gentle stroking towards the nipple, first from points near the areola and later from points at the periphery, will often detect the approximate location of the duct responsible for the discharge. We are opposed to diagnostic cannulization and retrograde injection of the ducts. Following the breasts, each axilla and each supraclavicular region should be gently examined for enlarged or indurated lymph nodes. If these are not found easily, they should on no account be sought for by repeated forceful pressure for fear of squeezing tumor cell emboli from possibly involved nodes.

Whenever palpation reveals a mass, the physical features of that mass should be observed and immediately recorded in writing in a sequence that gives clear verbal description, such as surface characteristics, consistency, shape, dimensions, mobility, relation to overlying skin, relation to underlying muscle and other facts. Immediate recording avoids the necessity of possible harmful subsequent examinations to check findings. The combination of the characteristics recorded will

usually justify a shrewd conjecture as to the benign or malignant nature of a mass, but will never indicate its exact nature with certainty For that, the evidence of a microscopic section is necessary.

Evaluation of Clinical Findings and Their Bearing on Advice.—If one constantly keeps in mind the patient's welfare in terms of the distant as well as the immediate future, evaluation of positive clinical findings will lead to one of three conclusions and resulting advice:

Conclusion 1· The lesion feels so much more like thickened breast tissue than any form of neoplasm or cyst that at least a short period of waiting and close observation is justified.

Conclusion 2 The lesion has very obvious characteristics of cancer. Here the only contraindications to advising immediate radical surgery are hopelessly advanced states of growth with fixation, severe concomitant disease, and occasionally age.

Conclusion 3 The lesion lacks any *sure* characteristic of cancer but feels definitely more like neoplasm or cyst than like thickened breast tissue In all such cases advice of immediate biopsy excision of the lesion with a generous margin of contiguous normal tissue is the only course that adequately safeguards the patient's future. We know from experience that some innocent feeling masses *are* cancer, especially the small ones, and we know the folly of waiting for such clinical signs of cancer to appear before operating In this connection, we distrust needle biopsy because we lack confidence in negative interpretations therefrom and because local excision is a procedure with negligible hazard Advice of local excision presupposes facilities for quick gross and microscopic diagnosis by a qualified pathologist at the time of operation Furthermore, biopsy excision of a breast lesion is never done without the patient's consent to immediate radical surgery if cancer is found or to simple mastectomy if such seems clearly indicated for prophylactic purposes

PREOPERATIVE MEASURES AND ANESTHESIA

Whether a primary radical mastectomy or biopsy excision is advised, we insist upon having the patient in the hospital for at least twenty-four hours before operation This allows time for a complete physical examination including chest x-rays and blood typing in order that replacement blood may be reserved at the blood bank

Our usual anesthetic routine for all breast operations is adequate barbiturate sedation the night before and at operation a mixture of small amounts of cyclopropane with ethylene, preceded by conservative doses of morphine and atropine, adjusted to the patient's weight. In addition

to the arm, axilla and chest, the abdomen and thighs are shaved and scrupulously cleaned to serve as possible donor sites for skin grafts.

OPERATION

General Concept.—The operation of radical mastectomy is in a sense an attempt to answer this question: "How can an entire breast containing a cancer, together with the underlying pectoral muscles and the fatty-areolar, lymph node containing contents of the axilla be removed, all in one piece, *with minimal manipulation and compression of the tumor*?" The best answer to that question is so to plan the incision and arrange the sequence of steps in the operation that traction on the breast need be exerted for only a few minutes and at the outset. Such a sequence of steps is as follows:

1. Incision.
2. Dissection of lateral skin flap.
3. Dissection of medial skin flap.
4. Exposure and section of insertion, clavicular origin and sternal origin of pectoralis major in that order.
5. Section of insertion of pectoralis minor and coracoid fascia.
6. Dissection of upper axilla.
7. Section of origins of pectoralis minor.
8. Dissection of lower axilla and removal of specimen.
9. Closure—with or without skin graft.

Choice of Incision.—The incision we use consists of two linear portions above and below the breast, joined by an elliptical portion, encircling the breast (Fig. 369, *a*). The linear portions lie in the straight line that runs from just below the juncture of the middle and outer thirds of the clavicle, downward and a little toward the midline until it reaches the upper end of the anterior rectus sheath at the costal margin. The points where these linear incisions divide and rejoin to surround the breast are determined partly by the quadrant of the breast in which the tumor is located and partly by the size and shape of the particular breast. The skin overlying the tumor, whether attached or not, should be excised widely, leaving a margin of fully 5 cm. (2 inches) in every direction from the growth. The maximum width of encirclement should continue to the level of the nipple and the ellipse should be curved into the linear portions above and below. At first these incisions should be carried only through the skin, and such superficial veins as are encountered should be cut between clamps and ligated at once. For ligatures, we prefer fine or medium black silk.

If a biopsy excision of a tumor is done first to establish whether more

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masses are usually small. For the lower half of the breast, a curving incision following the margin is useful. For the upper half of the breast, a crutch-shaped incision gives good exposure with little mutilation (Fig. 369, *b*). It consists of a short incision radiating outward from the areola and a curving portion just outside and following the circumference of the areola.

Dissection of Lateral Skin Flap.—Next begins the dissection of the lateral skin flap. It is during this stage that some traction on the breast is necessary to gain better exposure. This traction, exerted through a number of vulsellum clamps applied to the skin edges, must always be made perpendicularly outward from the chest wall and never across the breast. The latter practice squeezes the breast tissue and tumor against the chest wall and risks loosening tumor-cell emboli. Traction on the lateral skin edge also helps dissection, but one should be careful never to transfer vulsellum clamps from the skin overlying the breast to the edge of either skin flap. Whether dissection of the flap begins above or below is immaterial, but throughout, no more than a very thin layer of subcutaneous fat (less than 1 cm.) should be left adherent to the skin.

This early stage of the operation should not be hurried at the expense of careful hemostasis, otherwise much blood will be quickly and needlessly lost. Control of bleeding from the larger blood vessels encountered in a radical mastectomy is a far easier part of the operation than the control of diffuse bleeding from many small vessels in the large subcutaneous area uncovered as dissection proceeds. One has to be especially cautious with patients who are hypertensive, obese, or whose small subcutaneous vessels are usually numerous and complex in pattern. Vessels clamped on the under side of the skin flap should be promptly ligated. Whether the clamped vessels on the breast side of the incision are ligated depends on the number of hemostats available.

The lateral skin flap is dissected back to a point opposite the outer border of the latissimus dorsi muscle. Following that edge upward will lead one to the pectoralis major at about the point where division of that muscle from its humeral attachment will later be carried out. Dissection continues across the anterior surface of the pectoralis until the cleft between it and the deltoid is identified by visualizing the cephalic vein.

Dissection of the Medial Skin Flap.—The next step is dissection of the medial skin flap. From this point on, no further traction on the breast is necessary since gravity will cause it to fall away from the immediate field of operation. An equally thin layer of subcutaneous fat is left on the medial flap as on the lateral. The dissection extends above close to the lower margin of the clavicle and medially to the edge of the sternum.

extensive surgery is necessary, the incision used should be so placed as not to interfere with that of a radical mastectomy It should nevertheless give sufficient exposure for easy dissection of the subcutaneous tissues

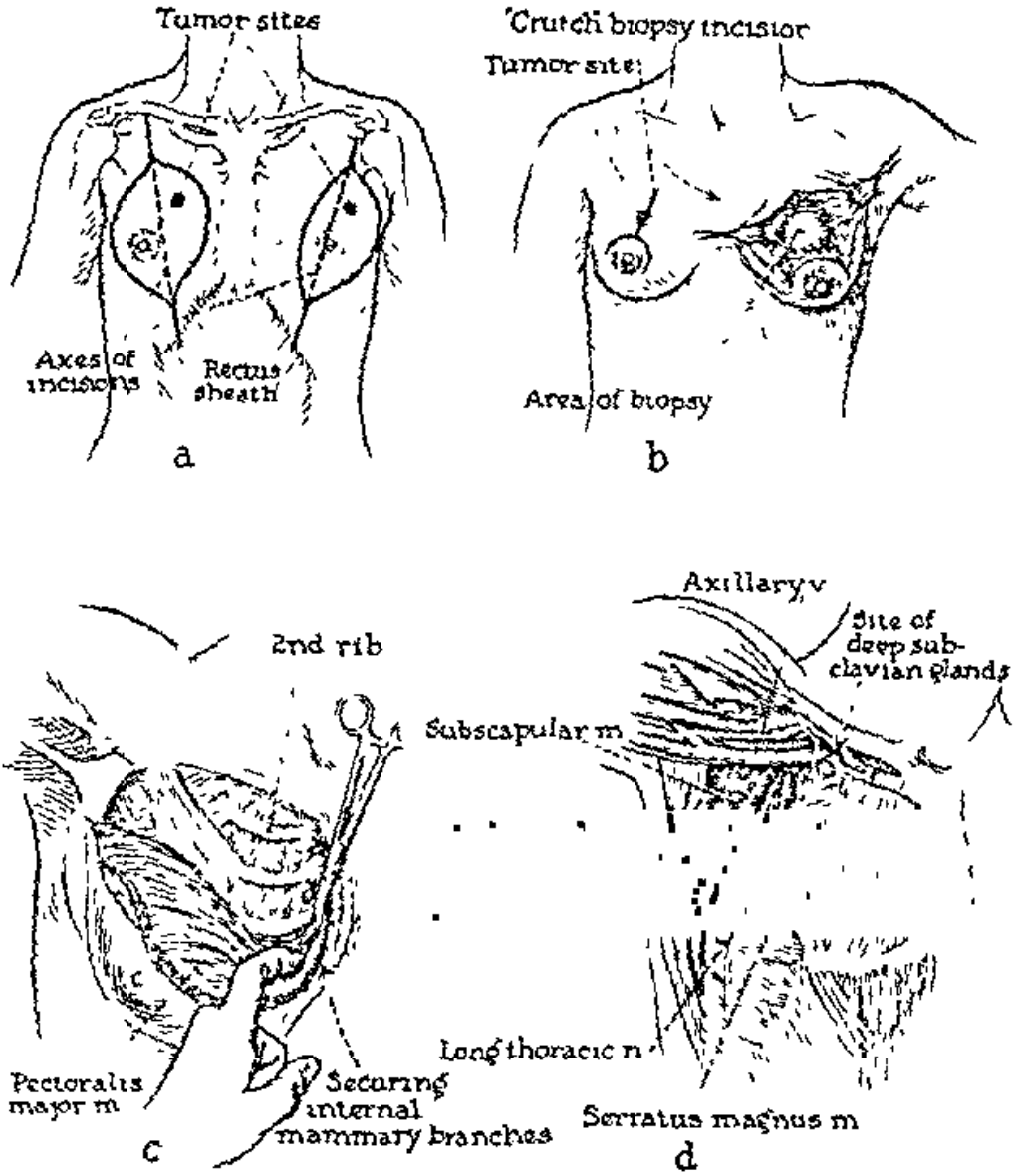

Fig 869 —a, Placement of skin incision according to the location of the tumor (see page 1281)

b, Exposure gained by use of "crutch" incision for biopsy excision of nodules in upper half of breast (see page 1283)

c, Methods suggested on page 1284 for securing perforating branches of internal mammary artery

d, Location of highest axillary lymph nodes and of the cleft between the subscapularis and serratus muscles mentioned on pages 1285 and 1286.

without the necessity of forcible retraction or extensive undercutting. If the mass is found to be malignant, this biopsy incision should be closed and not made part of any larger incision Fortunately, puzzling breast

they are encountered (Fig. 369, *c*). Due to the direction in which these vessels emerge, they can be clamped most easily by the operator when the left side is involved and by his assistant when the operation is on the right side.

Before the pectoralis major can be entirely freed from the chest wall, an inconstant number of smaller intercostal perforating vessels must be secured which emerge to enter the muscle at several levels near the nipple line. One must also extend the dissection of that muscle around the broad curve of its inferior portion and in so doing excise a generous portion of the uppermost part of the anterior rectus sheath. As the pectoral muscle and breast fall away to the side during the above dissection, the large expanse of chest wall that is bared should be covered and kept covered with gauze pads thoroughly moistened in physiological salt solution at body temperature.

The Pectoralis Minor and Upper Axilla.—With its major barrier removed, the upper axilla is now covered only by the minor pectoral muscle and the fascia which surrounds it. This lesser barrier is now severed in three quick, easy steps. The coracoid fascia is first incised along each border of the muscle, the left forefinger is inserted behind to draw the muscle away from the underlying vessels and brachial plexus and the muscle is cut 3 to 4 cm. from its insertion. Higher division adds nothing to exposure and makes more difficult the otherwise easy control of a rather active bleeder usually encountered. Next, the coracoid fascia is sharply cut, not torn, along the line of the underlying vessels, first outward to the shoulder and then inward to the sternoclavicular junction.

With the continued purpose of letting gravity help as a retractor wherever possible, one now commences the block dissection of the axilla by cleaning out the little pyramidal space bounded above and medially by the sternal head of the clavicle, below by the first rib and behind by the axillary vein. Here lie the two or three highest and most inaccessible of the axillary lymph nodes. Although this and other parts of the axillary dissection can be accomplished more quickly by sweeping with a gauze-covered finger tip, we believe the slower method of combining sharp scalpel dissection with gentle teasing of the gland-bearing areolar tissue away from the axillary vein, chest wall, large vessels and nerves is productive of more thorough results. (Fig. 369, *d*.)

As soon as these few highest nodes are freed, the rest of the axillary dissection can proceed methodically without further delay or difficulty if the fatty-areolar tissue is worked free in one mass, first from above the axillary vein in the region of the axillary artery and brachial plexus and then around in front of the vein, always working from the midline outward toward the shoulder. As small vessels are encountered, they are

divided between mosquito clamps and promptly ligated. As the antero-inferior aspect of the axillary vein is exposed, its major branches are easily and cleanly uncovered, divided and secured. Running close beside the veins are the corresponding branches of the axillary artery and the nerves to the two pectoral muscles.

After the upper and anterior aspects of the axillary vein have been cleared, its under surface must be cleared to expose another important pocket of areolar tissue containing lymph nodes. This lies in the narrow cleft bounded above by the vein, posteriorly by the subscapularis muscle and medially by the chest wall (Fig 369, *d*) The dissection of this pocket commences at its upper, medial angle and works downward and outward. Here one encounters the nerves to the serratus magnus and latissimus dorsi muscles crossing the depths of the wound and running close to the main vessels supplying those muscles The lateral cutaneous nerve is also encountered An attempt to spare these three nerves should be made if doing so does not slow down the dissection unduly Any or all should be sacrificed ruthlessly if they are found to run through or even close to tissue obviously containing tumor Before the two motor nerves are traced toward their respective insertions, it will be necessary to sever the origins of the minor pectoral muscle where the latter interdigitate with the fasciculi of the serratus magnus, and to dissect out the fatty tissue between the border of the latissimus muscle and the chest wall If in the beginning the lateral skin flap was thoroughly dissected up to the border of the latissimus dorsi, the entire specimen of breast, muscles and gland-bearing areolar tissue finally comes away in one piece

Closure of the Wound.—The breast and attached structures having been removed, preparations for closure are begun by methodically reviewing the entire wound area for small bleeding vessels that may have escaped notice To further the accuracy of this search it is desirable, if possible, to have the patient's blood pressure as close as possible to its level at the start of the operation

Wound closure after any long, exacting operation is at best a tedious procedure that must be undertaken at a time when fatigue begets impatience and dulls judgment In the case of a radical mastectomy, termination of the operation cannot follow a set routine, but must be approached as an exercise in plastic surgery. The basic problem is to reapply each skin flap to the chest wall and hold it there by such means and over such an area that (1) the axillary vein will be covered, (2) there will be no skin slough from tension, and (3) full arm motion and good function will be preserved If strict adherence to these considerations permits complete approximation of skin edges without tension, so much the better It is most often possible in thin individuals with small, flac-

cid breasts, and occasionally possible in larger, pendulous breasts. We have not found complete closure possible in the erect, virginal type of breast or in tumors of the upper, outer quadrant without compromising adequacy of skin removal.

If skin edges will obviously not come completely together, the flaps are attached to the chest wall in the desired location by stitching their under surfaces here and there to the intercostal muscles, and as much of the upper and lower linear parts of the incision are closed as will approximate *without tension. Either a primary or a delayed skin graft should* secure healing of the uncovered area in two or three weeks, far sooner than occurs when tightly closed skin edges slough. Well-given anesthesia, blood replacement by transfusion during operation, and careful hemostasis should permit the additional half hour necessary for primary skin grafting and we prefer that procedure. If any doubt exists as to the patient's condition, or if there are associated factors such as marked hypertension, diabetes, age and other conditions it is better to resort to a delayed graft unless the area to be covered is very small.

For primary grafts we use the dermatome for any area wider or longer than 7 to 8 centimeters For smaller areas, freehand split thickness grafts can be cut with Blair-Brown knife or a small dermatome graft can be cut. For small delayed grafts there is little to choose between split thickness or pinch grafts, but for delayed grafting of large granulating areas we have found pinch grafts more dependable and apply them from the sixth to the ninth day after operation.

Wound Dressing.—Adequate dressings and secure bandaging play important roles in aiding the beginnings of wound healing. Elastic adhesive plaster serves best to keep even pressure on a large fluffy gauze and mechanics' waste dressing and prevent it from shifting on the skin. To prevent movement between skin flaps and chest wall, however, it is necessary to supplement this inner dressing with an 8 inch wide gauze roll which completely encircles the thorax and is left in place for two to four days. Skin graft donor areas are covered first with a single layer of rayon silk and then with several layers of sterile gauze, secured by elastic adhesive. Sprinkling a few grams of sulfanilamide crystals between the layers of these gauze dressings (not on the wounds themselves) will greatly prolong the time dressings can be left in place without becoming offensive.

IMMEDIATE AFTER-CARE

The postoperative course after radical mastectomy is ordinarily uneventful and without need for unusual therapeutic measures. We make sure that these patients practice deep breathing, active leg movements

and frequent change of position but in order to help keep the wound surfaces quiet, we do not ordinarily ambulate them for four or five days. We like to leave the breast dressing in place for five days before changing, and the donor area dressings for fourteen to twenty-one days

Preservation of arm motion is one matter needing special attention Our concept of this problem is that if free painless passive motion of the head of the humerus in the glenoid cavity is maintained, full, painless active motion will follow as a matter of course as soon as soreness leaves the wound. We therefore stress only those active motions of the humerus that are short of arm-raising and instruct the patient how to use her sound arm to help the other in more extensive passive movements. Such passive movements are begun the day after operation

AFTER-CARE AND FOLLOW-UP

Keeping track of patients who have undergone a radical mastectomy is both a matter of scientific interest and professional conscience The best guide to immediate and later frequency of follow-up is the knowledge gained at operation of whether or not axillary lymph nodes are involved When the nodes contain metastases, one knows that even with a wholly satisfactory local operative result, 60 to 70 per cent of those individuals will die of metastases within five years, usually within two years Knowing the long-proven palliative value of roentgen therapy and the recently established encouraging results of treatment with androgens, one is obligated to watch this group of patients with unfavorable outlook closely enough to institute palliative measures promptly, yet not so frequently as to keep them psychologically in a constant state of anxiety Clinic visits every two to three months during the first year and every four to six months for the second year seem desirable In the group whose axillary nodes are not involved, the prognosis for survival is almost exactly reversed For that reason, the frequency of follow-up visits may well be relaxed to three times during the first year and twice during the second. After two years have passed it is difficult to get patients back for observation oftener than once a year. When patients are followed this closely one is sure to encounter and have to supervise many difficult and distressing terminal and preterminal situations. On the other hand, one has the satisfaction of knowing all the facts about outcome and of observing good results over many years.

ACUTE SUBDURAL ABSCESS

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INTRODUCTION

SINCE the era of the antibiotics the management of inflammatory cerebral conditions has required reconsideration. The treatment of meningitis has been revised with spectacular success. The existence of an intracerebral brain abscess now offers the prospects of a cure through modern therapy. A subdural abscess, considered usually a fatal lesion, presents a far less hopeless outlook.

It is with the latter lesion that the following report is mainly concerned. Since an intracerebral abscess developed concomitantly in two of the four cases under consideration, the management of intracerebral abscess will also be reviewed in the brief discussion of the group. The literature of subdural and brain abscess has been dealt with in detail elsewhere.[1, 1a, 2]

The four cases which are surveyed in detail were encountered since January 1944 as consecutive patients, presenting in each instance a subdural abscess. A uniform method of management was employed at the outset; namely, drainage of the collection by trephine openings with the instillation of penicillin. The original focus was treated as necessary; i.e., by removal of osteomyelitic bone, radical frontal sinus operation and other treatments The complications which evolved were not uniform and thus may be of interest. The success of treatment emphasizes the modern role of the antibiotic and chemotherapeutic agents in this somewhat unusual but important condition.

CASE REPORTS

CASE I.—L. P., a 17 year old white woman, presented a history of chronic frontal sinusitis with exacerbation of an acute attack nine days before hospital admission She had been treated by penicillin and sulfadiazine for eight days before admission. By clinical evidence, the sinus involvement was greater on the right than on the left Roentgen studies showed "a pansinusitis with a diffuse clouding of the frontal, sphenoid and right ethmoid sinuses. A definite thickening of the mucous membrane lining of the left ethmoid and both maxillary sinuses is

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demonstrated " An edema of both orbital areas and the right maxillary region was noted Nuchal rigidity was present A mixed aphasia with a right hemiparesis had developed The spinal puncture pressure was 200 mm. (H_2O), the fluid being clear and without cells There was blurring of the margins of the right optic disk. The blood count and temperature were normal on January 6, 1946 Rightsided Jacksonian convulsions occurred on the day of admission to the hospital as well as subsequently A total of nine attacks of varying duration occurred before operation An intern's note stated that the convulsion "starts with jerking of the head from side to side The right side of the face contracted and the eyes jerked only occasionally; the convulsion progressed to the shoulders and clonic contractions occurred, after a minute, they advanced down the body, affecting the right side first Contractions are at first clonic and then become tonic After legs become involved, the convulsion rapidly subsides "

Four days after admission, a trephine opening was made in the left frontoparietal area resulting in evacuation of a large subdural abscess The opening was enlarged and the site of the collection was drained and irrigated by means of a catheter Seventy-five thousand units of penicillin solution was instilled The wound was closed without drainage Improvement occurred immediately and continuously Eleven days after admission, bilateral frontal openings were made for inspection of the subdural space. The right side was normal A small quantity of pus could be irrigated from the left side Penicillin solution was again instilled The recovery continued, interrupted by acute appendicitis, followed by an appendectomy Two transient convulsive attacks occurred, one involving the right side of the face, the other the right hand Culture of pus resulted in no growth of organism The patient was discharged twenty-nine days after admission.

Follow-up—This patient, fortunately, has had no significant neurologic sequelae since hospitalization There have been no convulsions The patient has been employed gainfully during the past two years.

Case II—M E , a 36 year old white man, presented a history of sinusitis for six years On April 16, 1946, he had had generalized headache and was given symptomatic treatment Fever developed and the "sinuses were drained" Swelling of the forehead, nose and eyelids with an abscess of the frontal area of the scalp resulted in the latter being incised The patient did not improve and was hospitalized Jacksonian convulsions occurred involving the entire left side of the body He was seen in neurosurgical consultation on May 5, 1946. He was stuporous, having continuous left-sided convulsions associated with a left hemiplegia On the evening of May 5 an emergency trephination was done. Upon incision of the dura through a right frontal opening, there was a gush of yellowish, creamy pus under severe tension An opening was also made in the right temporal area Catheter drainage was used at each opening after instilling penicillin solution

Roentgen studies of the skull showed the existence of a pronounced paranasal pansinusitis with considerable reduction in the air contents of these spaces; this was most marked in the left maxillary antrum

The spinal fluid white cell count was 0 and cultures of spinal fluid were nega-

tive at admission for surgical treatment. The highest subsequent cerebrospinal fluid cell count was 19. The evacuated pus yielded a staphylococcus organism upon culture. After an immediate improvement, the patient then failed to progress. He experienced a right-sided Jacksonian convulsion; fever continued; a drowsiness persisted On May 16, eleven days after the first trephine, a left frontal opening was made with evacuation of a second subdural abscess, cultures again showing a staphylococcus organism The original openings on the right side were reinspected and no further accumulation was found. A catheter was inserted in the left opening for instillation of penicillin. The right temporal opening was enlarged.

The patient again improved, becoming alert, oriented and cooperative. He presented a partial mixed aphasia and a left hemiparesis His sulfadiazine level reached 7 6 mg per 100 cc. Both local and systemic penicillin were used. Local instillations were made for four days postoperatively Systemic penicillin was employed until discharge on June 14, forty days after admission

The electroencephalogram after the second collection had been drained was characterized by depression of activity in general It was concluded that the right frontal lobe was barely maintaining electrical activity No convulsive episodes were recorded

The patient remained without major complaints until July 14, 1946, when he again became drowsy, with thickness of speech and headache. He had two generalized convulsions. The patient was readmitted on July 16. Examination showed the persisting left hemiparesis with confirmatory signs. The fundi were normal. There was bulging of the right temporal opening. The spinal fluid protein was 112 mg. per 100 cc ; there was a normal cell count.

On July 19, a ventriculogram was attempted through occipital burr openings Upon incising the dura in the right occipital area there was an immediate release of pus under pressure A small catheter was inserted and penicillin solution used to irrigate the subdural cavity The patient seemed to arouse. Several days later, since improvement did not occur as expected, a ventriculogram was performed through the normal left occipital opening This showed a space-occupying lesion in the right frontal area On July 30 an encapsulated abscess was excised in toto by means of a craniotomy The mass ruptured during excision. The dura and scalp were tightly closed after instillation of 100,000 units of penicillin. The following day a generalized convulsion occurred. Daily instillation of penicillin was employed with injection both into the area of the abscess (through the closed scalp) and into the cerebrospinal fluid by lumbar puncture The highest spinal fluid cell count was 18 white blood cells. Although desperately ill, requiring nasal tube feedings and constant nursing care, the patient slowly progressed. The temperature reached 105° F , several generalized convulsions occurred Local instillation of penicillin into the abscess cavity was not discontinued until ten days after craniotomy Cultures uniformly showed a staphylococcus organism, the infecting agent in all the collections The patient was discharged thirty-two days after admission with a residual hemiparesis and partial aphasia

Follow-up—During 1947 the patient convalesced at home He was unable to work. Fifty-two generalized convulsions occurred in spite of a carefully con-

trolled program of anticonvulsant drug therapy. By 1948 the patient was approaching normal activity. He was driving his car. Return to his occupation as a tool and die worker became a reasonable possibility

CASE III.—J Mc., a 27 year old white man, developed a right frontal sinusitis following an upper respiratory infection He developed Jacksonian convulsions and stupor associated with left hemiparesis in a period of three days Radical frontal sinus operation was done, followed by trephine and evacuation of large subdural abscess He was discharged as cured thirteen days later

This patient was stated to have had a cold followed by a right frontal sinus infection with tenderness and redness of the overlying tissue Under conservative treatment he developed fever, then twitching of the left face and upper extremity On January 10, 1947, Jacksonian convulsions occurred involving the entire left side of the body. By means of a coronal incision, a frontal sinus operation was performed by the otologist on January 12, the posterior sinus wall was removed, the dura was yellowish and pus exuded from the subdural space Upon opening *the dura, only a minor quantity of pus drained Following the sinus operation* convulsions occurred with greater frequency, paresis of the left arm, leg and face were noted, and the patient was semiconscious An emergency right frontal trephine was made on January 15, resulting in the evacuation of three ounces of yellowish pus from the subdural space A catheter was inserted for penicillin instillation.

Laboratory examinations on January 11 showed the spinal fluid cell count to be 6. The total protein was 57 5 mg , chlorides, 530 mg , sugar, 130 mg A culture was reported as showing a nonhemolytic streptococcus The hemoglobin was 12 2 gm., the red blood count was 4,240,000 and the white blood count was 14,100. Continuing Jacksonian convulsions required 12 gm of sodium amytal from 10:30 P.M. on January 15 to 9:30 A M on January 16 On the latter date, a right temporal trephine was made as well as an opening in the left frontal area No pus was encountered. The surface of the brain was reddened The convulsions became less frequent and stopped on January 18 The patient became conscious and cooperative. Survey roentgen studies showed considerable opacity involving the right maxillary antrum and the posterior ethmoids as if from infection in these spaces Irrigation of the antrum showed pus present Laboratory studies showed a penicillin serum level of 0 units, a sulfadiazine level of 10 8 mg on January 16 The patient rapidly recovered without complication An encephalogram before discharge showed no cortical air markings over the right hemisphere The ventricular system was normal. There were no cells in the cerebrospinal fluid

Follow-up.—One year later, an osteoperiosteal cranioplasty was done to close a pulsating defect in the right frontal area, the site of the sinus operation The patient had had a total of three convulsions during the year He was employed at his former occupation

CASE IV.—F W , a 32 year old man, was well until six weeks before admission. About that period he "had had a wire put in his nose" for treatment of sinusitis Two days after treatment, he noted infection in the frontal area of the scalp

which was characterized by erythema and edema. He was hospitalized and treated with penicillin An abscess localized over the right frontal sinus This was drained He improved but after discharge from the hospital the inflammation reappeared with a re-collection of pus Again he was hospitalized and again an abscess was drained. One month after the onset of his illness, cellulitis and pain occurred at the vertex This proceeded to suppuration, and later surgical drainage resulted in evacuation of thick yellowish pus Several days later, he awoke in the morning at his home with a right hemiplegia and expressive aphasia and was hospitalized

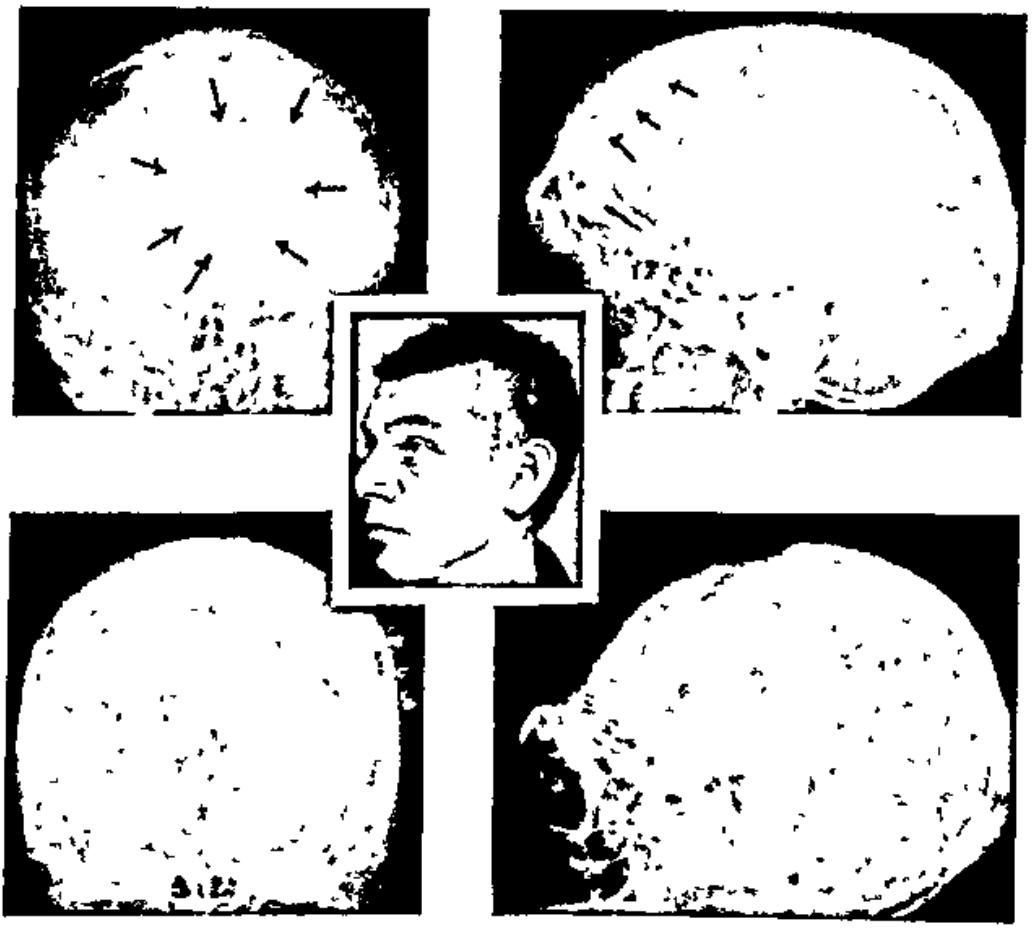
Upon admission to the neurosurgical service on July 23, 1947, the patient was found to be acutely ill with a fever of 103 2° F He was apathetic and aphasic A right hemiplegia was present involving the face. Nuchal rigidity was absent There were normally outlined optic disks A lumbar puncture showed the cerebrospinal fluid pressure to be 350 mm of water; the cell count was 14. Roentgen survey studies of the skull showed an extensive osteomyelitis of the frontal area of the skull, extending well up to the vertex (Fig. 370) Within the area of destruction were irregular shadows having the appearance of sequestra. On the day following admission, operation was undertaken by means of a coronal excision A 4-inch block of osteomyelitic bone was encountered in the midfrontal area extending along the sagittal sinus The posterior walls of the frontal sinuses were involved and were removed. There was no purulent collection within the sinuses The dura over the left frontal area appeared to be abnormal. It was incised, releasing 3 ounces of pus. The cortical surface was covered by a thin layer of exudate and a membrane. Since the subdural collection extended into the temporal area, a counter opening in the bone and dura was made in the temporal bone Catheter flushing of the subdural space with penicillin solution was done, the catheter being allowed to remain in position for daily instillation of penicillin

Several hours after operation, the patient had a short episode of a right facial convulsion. Jacksonian convulsions recurred the following day, each of longer duration. The right arm as well as the face became involved Daily instillations of penicillin were continued both under the scalp and into the subdural space by catheter and into the subarachnoid space by lumbar puncture The highest cell count in the spinal fluid was 205 polymorphonuclear cells Cultures of the pus showed it to be sterile. Both penicillin and sulfadiazine were used systemically. Gradual improvement occurred manifested by return of power in the extremities and slight speech ability. He was discharged thirteen days after operation.

Thirteen days later, on August 19, the patient was readmitted since he noted a failing in the regained power of the right upper and lower extremities as well as in the speech. Severe right frontal and occipital headache had occurred A hemiparesis was present with confirmatory reflexes. A left third nerve paralysis was also noted.

A trephine opening was made on the left side 1½ inches above the left ear, on August 21. There was no subdural collection A brain cannula inserted into the cerebral tissue encountered an abscess 3 cm. from the surface. One-half ounce of thick yellowish pus was removed and 25,000 units of penicillin inserted. Instillations of penicillin were employed intrathecally following primary tap of the

abscess. Four days later, a second tap of the abscess was made, again injecting penicillin locally The patient remained lethargic, the hemiplegia was complete as was the aphasia A third tap was made on September 2 After this procedure, improvement could be observed with return of power in the lower extremity followed by movement in the upper A fourth tap on September 9 did not strike pus Direction of the cannula into the frontal lobe also failed to strike a collection



The patient became alert, developing an ability to form simple words Two generalized convulsions occurred. Progress continued without interruption. The patient became ambulatory, only the aphasia remaining as the outstanding defect. On October 3 an encephalogram was performed which showed no ventricular distortion He was discharged October 7, after forty-nine days in the hospital It is of note that culture of the pus evacuated on August 21 showed a nonhemolytic streptococcus while that of subsequent cultures we ерile The blood sulfadiazine level reached 3 2 mg The al fluid always ıormal

The patient's temperature remained below 100° F. except for one rise to 101° F.

Follow up—This patient still has some degree of motor aphasia (as of April 5, 1948) and there have been three grand mal seizures since discharge from hospital The skull defect is to be repaired in the next six months. The patient has been working for the past four months

COMMENT

A review of available knowledge considered with the data of the cases herein reviewed *permits certain limited clinical conclusions.*

First, the clinical signs present appear to vary with the types of subdural abscess which occur; namely, (1) the acute subdural abscess, or (2) the chronic subdural abscess

The acute subdural abscess is the commonest and the most treacherous. An essentially well individual may develop an acute frontal sinus infection and five to ten days later may be stuporous or comatose with or without a lateralizing paralysis. This time interval is of importance. The occurrence of Jacksonian or generalized convulsions is a second important sign which may indicate the presence of this expanding cortical lesion. Other evidence of increased intracranial pressure may be present. A pleocytosis of the cerebrospinal fluid may occur. Paresis or paralysis may develop These latter findings are characteristic of any inflammatory lesion of the brain or meninges.

The chronic subdural abscess appears to be a well-localized process occurring as a complication of mastoid sinus disease. If a patient escapes from a sinus thrombosis, meningitis, or intracerebral abscess, this process may occur and may be attended by ulceration of the surface of the underlying brain. Chronicity is characteristic, as illustrated by the four cases cited by MacEwen.[3] His cases were of three weeks, time unknown, four months, and four months respectively. In the first instance a discharging ear had been present for eighteen months. It is of interest that the ages of these patients were 19 years, 9½ years, 22 months and 2 years, respectively. All but one recovered following operation.

It is reasonable to believe that this type of subdural abscess is encountered by the otologist in distinction to the acute abscess, which demands neurosurgical intervention. Early mastoid surgery has now made this lesion a rarity.

Second, intracerebral abscess may accompany or subsequently follow an acute subdural abscess Of the four cases presented, two patients developed brain abscesses, one during hospitalization and the other one month after discharge. In each patient a dramatic response occurred after drainage of the subdural abscess. Relapses in both cases resulted in pneumoencephalograms which in turn showed the complicating frontal lobe abscesses. These were successfully treated, the right frontal lobe

abscess by enucleation and that on the left by tap and instillation of penicillin. Typical localizing signs may thus attend an interruption of a patient's progress after an encouraging immediate recovery. This calls for investigation without delay.

Third, convulsions may occur postoperatively as well as preoperatively and may be a permanent sequel to the disease. Of the four patients in this group, three have had convulsions since discharge from the hospital In Case III, the convulsions which occurred following operation were of the order of a status epilepticus This patient has had three grand mal attacks since discharge. Case II was handicapped earlier by frequent generalized convulsions, although the attacks have lessened after two years Case IV has had two convulsions, while Case I has had none.

TREATMENT

In the past, treatment of subdural abscess has been by means of drainage of the purulent collection through trephine openings. Chance played an important role in determining a successful outcome, but drainage adequately established and maintained proved effective since some patients so treated lived The mortality was high as has been pointed out by Kahn[4] who stated that two out of twelve patients within his experience had survived

It is now possible to evacuate not only a subdural collection but to sterilize the infected cavity as well as the primary focus of its origin. It is possible to produce, by antibiotic and chemotherapeutic measures, a host resistance which combats the existing infection and arrests further invasion Added to this important therapeutic accomplishment are those contributions to surgical progress including refinements in surgical technic, the employment of blood and plasma and an application of the knowledge concerning body chemistry and metabolism.

A first step in treatment must concern the original focus for the complicating subdural collection. By means of pertinent studies, this may be identified That focus is then surgically treated as soon as suitable conditions can be established There is no gain by delay.

An empyemic frontal ethmoid or sphenoid sinus disease must be evacuated An osteomyelitis of the skull is removed. Suppuration of the mastoid sinus and temporal bone is attacked. This step may reveal a dural sinus or abnormality of color, texture or surface reaction suggesting and leading to an underlying collection of pus.

A second step may be made either independently or in conjunction with the eradication of the focus. This may be done independently since the origin of the subdural abscess may not require surgical treatment as in Case II This procedure is trephination, evacuation of the

abscess, irrigation of the cavity with penicillin solution and catheter drainage. Usually a frontal and temporal trephine opening only is necessary. Kahn has found that a lumbar puncture during operation was helpful in preventing loculation of pus. There is no need for wide bone removal. It may be necessary to employ a posterior opening in a massive collection. Fifty thousand units of penicillin in 5 cc. of saline is flushed intothe cavity by means of a soft rubber catheter. The catheter is left in place for daily instillation of penicillin solution for three days. It is then removed.

Although a diagnostic procedure, a final air study must be considered as part of the program of treatment since an associated brain abscess may be present, the subdural collection may be incompletely evacuated or the opposite hemisphere may be involved. When this study is normal, the patient may be discharged with assurance that he is in all probability cured.

General measures include the use of systemic penicillin and sulfadiazine in adequate doses If an associated meningitis is present, intrathecal penicillin is used twice daily in doses of 20,000 units barbitized in spinal fluid. Blood transfusions and nasal tube feedings of an adequate diet may be necessary.

The suggestion has been made that an osteoplastic bone flap operation be used in treatment to drain more adequately the subdural space.[5] There may be cases where this procedure is indicated. However, it would seem reasonable to obtain drainage by the simplest measure, reserving a more radical operation only for the patient who did not improve.

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THE PRESENT STATUS OF THE TREATMENT OF BURNS

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IN spite of the title, this article should not be construed as reflecting the consensus of a considerable number of contemporary writers on the subject of burns. Rather, it is an informal account of the plan of procedure used in one institution, and in the interests of simplicity, much controversial and theoretical material will be omitted. At the outset I should state that I cannot agree with the authors of the following statement: "The care of an acute burn can, from the point of view of the professional care needed, best be compared to that of diabetic coma or advanced tetanus."[1] It is true that the treatment of burns can be as complicated as we choose to make it but it may also be true that it can be relatively simple if it is stripped to its known essentials. During ward rounds recently, a visitor asked "How do you treat burns?" The answer was· "We don't." This impertinent reply was followed by the explanation that we do not actually treat the burned skin—we cover it up and leave it alone It will either heal of its own accord or in three weeks the third degree burn will have been converted to a granulating wound, no different from that due to skin defects which result from other forms of trauma. Of course, this granulating wound is treated by conventional skin grafting methods Neither is there any particular problem in the general treatment of 90 per cent of hospitalized patients with burns. The remaining 10 per cent who need special consideration constitute the exceptions and not the rule It has been my intention in this introductory paragraph to leave the impression, heretical as it may seem, that at the present time, it is relatively easy to give good treatment to the majority of individuals with burns.

HISTORY OF A TYPICAL CASE

The plan of treatment of a patient with severe burns can best be presented by relating the history of a typical case. The narration will be interrupted frequently to explain why a particular course of action was followed

CASE I.—F K., 39 years of age, was admitted to the Henry Ford Hosp.tal on April 4, 1944 In the course of his work in a defense plant, his clothing became saturated with gasoline and at this unfortunate time a fellow workman came near him with a blowtorch He was severely burned in the resulting fire He was ex-

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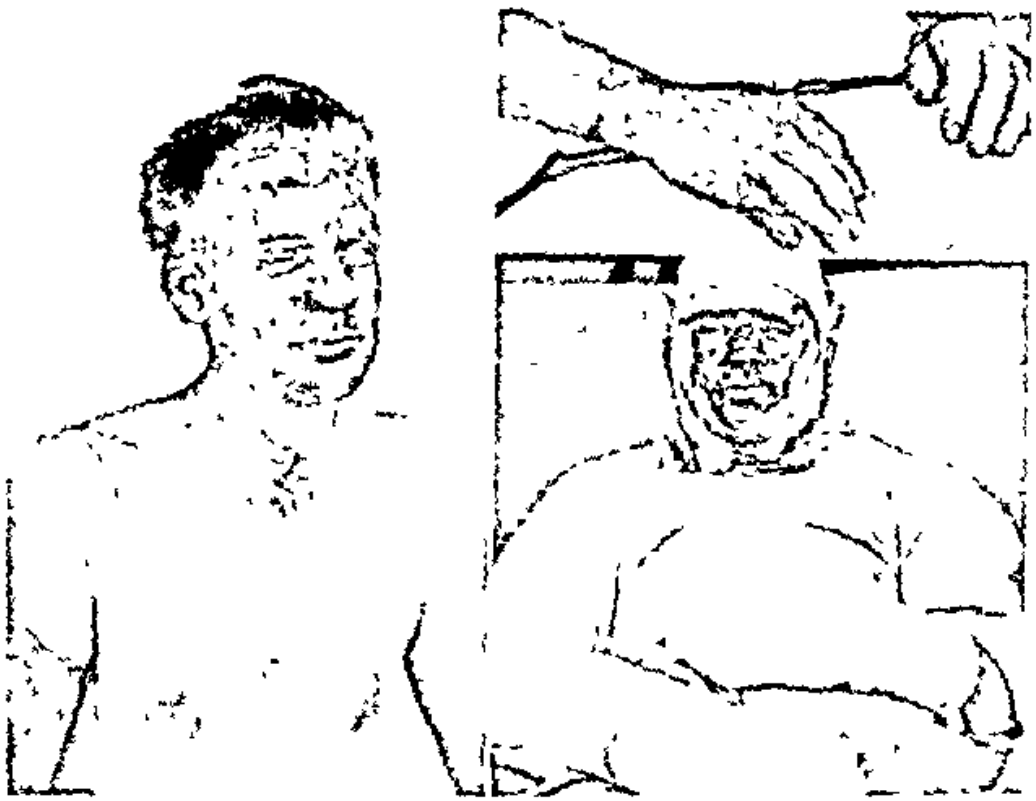
admitted in the emergency room one hour after the accident He presented burns of the face, neck, chest, both upper extremities and the right leg (Fig 371, *A* and *B*) The following points were of particular interest There was a deep burn of the face, including the orificial areas of the ears, mouth, nose and eyes There was a white, bloodless area on the right upper arm which was obviously of third degree Both hands showed blackened, elevated shreds of epidermis The injury to the right hand was obviously much worse than that of the left



A B C

FIG 371 (Case I) —*A* and *B*, Condition on admission Note the area of third degree burn on the right upper arm and the severe burn of the right hand *C*, Appearance two days later, showing occlusive dressings on hands and arms

The patient was immediately questioned as to the presence of pain Although he had had one quarter of a gram of morphine at the first aid station, he stated that the hands were still quite painful and he was given another hypodermic injection of morphine in the same dose For the clinical records, a rough diagram of the burned areas was made and photographs were taken, but no attempt was made at the time to estimate the area in square inches or percentage of body surface No treatment was contemplated in which such an estimation would have any influence. It must be admitted that no estimation was made until the writing of this paper. The reader is invited to make his own estimate from the photographs submitted, which show the extent of the injuries except for about 3 per cent in the region of the right knee Perhaps 20 per cent would be a reasonable estimate

Local Treatment First.—Within a matter of minutes, the local dressings were being applied. I desire to stress that during this early phase, no consideration was given to so-called general treatment, meaning of course, the treatment of the legendary "burn shock." For a number of years, it was customary to begin all articles and treatises on burns with the following quotation or its equivalent. "It is penny-wise and pound-foolish to consume invaluable time in applying perfect local dressings while the patient is sinking into irrecoverable shock." I believe that it is not foolish but wise to apply a good local dressing as soon as the patient is brought to the hospital. In deference to the authors of the quotation, we can state that the "perfect" dressing now recommended is easier to apply and the hazard of "irrecoverable shock" is not nearly so great as was once supposed. At any rate, it has been my experience that there is plenty of time to apply a dressing to relieve pain and minimize infection before it becomes necessary to attend to any details of blood volume replacement. It happened that the patient under discussion had an unburned area on the left arm where it was possible to make blood pressure determinations. *The initial blood pressure was 110/80, the pulse 84.* Even if burns of all four extremities had made it impossible to get a blood pressure reading, no infusion of plasma or blood would have been given in the emergency room.

No Débridement.—The burns of this patient were not débrided or cleaned in any way. There are those who would have advised that the patient be anesthetized so that all loosened epidermis could be removed and the raw areas scrubbed with soap and water. However, it is my belief that the unopened blister with its plasma bathing the underlying burn is probably the ideal dressing. Nothing is to be gained by removing the top of the opened blister. The application of antiseptics to the burn is to be decried The fire has sterilized the skin far better than any chemical or mechanical method which might be proposed, and it is useless to try to remove organisms which have been deposited on the wound since the injury. In extensive studies Meleney[2] found that excessive washing did not reduce the incidence of infection in burns. Therefore, the involved areas of the upper extremities were covered with petrolatum gauze and bulky dressings were applied (Fig. 371, *C*).

Type of Dressing.—An occlusive type of dressing rather than an open or eschar method of treatment was chosen because of a well-ingrained preference. Of the older forms of eschar treatment such as tannic acid, gentian violet and ferric chloride, nothing other than condemnation can be offered.[3] A recent paper entitled "A New Eschar Technique for Local Treatment of Burns"[4] contains the recommendation that burns be sprayed with an extract of beef aorta or covered with an ointment con-

taining such an extract (Epithene ointment) A review of the data presented would indicate that the method has no advantage over the use of the occlusive dressing. Furthermore, in a small series of experiments with guinea pigs, Ponka and Lam[5] demonstrated that Epithene was slightly inhibitory to wound healing

No particular brief can be made for the use of petrolatum gauze No doubt equally good results could be expected if fine mesh gauze wet with saline solution or plain rayon fabric were used next to the burned skin The fact to be stressed is that no proprietary ointment was spread on the burn before it was covered In this connection, it might be recalled that a few years ago a study was made of the substances used in the treatment of over 5000 industrial burns[6] Almost a hundred different ointments, powders and solutions had been applied None of these remedies had been subjected to critical investigation with regard to the effect on wound healing A few have been tested subsequently and no material has been found which exerts a detectable favorable influence The most widely promoted commercial ointments which have failed in objective, controlled tests are those containing vitamins A and D,[7] Biodyne,[8, 9] Hydrosulphosol[9] and chlorophyll.[10]

Application of Dressing.—The dressing is applied according to the following plan. The relatives or other onlookers are politely but firmly excused Operating room technic is followed as far as is practical This will include the masking of all persons in the operating room, including the patient The burned garments or first aid dressings are removed unless the latter are known to be of a satisfactory nature If an ointment and pressure dressing has been applied at a plant hospital for example, this should not be removed but is merely reinforced as indicated. As explained above, no cleansing or *débridement* is done The selected type of fine mesh, nonadherent fabric is then placed on the burned surfaces This means that the fingers must be individualized This layer is followed by ordinary gauze dressings outside of which is placed some type of bulky padding material such as machinist's waste or cotton pads Elastic bandage then completes the pressure dressing Ordinary gauze bandage, if skillfully and firmly wrapped, can be used in place of the elastic bandage which is more expensive. Dressings on the extremities should ordinarily include the toes or fingers to minimize swelling It is impractical and inadvisable to try to put pressure dressings on the face and neck In burns of the trunk, one may have to be satisfied with simply getting the injured surfaces covered in some fashion

In the case of the patient under discussion, a few strips of petrolatum gauze were placed on the cheeks and forehead for comfort, but no attempt was made to oppose the swelling which appeared in the soft tissues

of the face and neck (Fig. 371, *C*). Any possible disadvantage of this swelling was outweighed many times by the convenience of having the eyes available for irrigations, the nostrils available for cleansing with cotton-tipped applicators and the mouth available for feeding the patient and for the application of cold cream to the lips.

Subsequent Orders.—After the completion of the dressing described above, the patient was sent to a private room with the following orders:

1. May be up as desired.
2. Diet as desired. Encourage to take fluids.
3. Special nurses (a luxury but desirable because of the fact that both hands were in large occlusive dressings).
4. One grain of codeine every three hours if necessary for pain.
5. Record intake and output
6. Red blood cell count and hematocrit twice daily for two days

Course.—The next day or eighteen hours after the injury, the red blood cell count was 6,540,000, the hemoglobin 20 4 gm. and the hematocrit 69. These findings of hemoconcentration indicated some loss of plasma into the edematous tissues and into the dressings. Although there was no indication that the patient was in danger of entering into the state of so-called "burn shock," the blood pressure remaining steadily at about 110/80, he was given 2 liters of plasma. The next day the red blood cell count was 5,480,000, the hemoglobin 17 gm. and the hematocrit 56 This remaining hemoconcentration received no specific treatment and the next day (April 7) the red blood cell count was 4,200,000, the hemoglobin 13 1 gm. and the hematocrit 44 (normal).

Blood and Plasma Transfusions.—This patient was treated in 1944. If such a patient were admitted in 1948, I would change only one item in the whole plan of treatment, local and general, and that is with respect to the plasma transfusion. The blood of eight donors was necessary to produce the 2 liters of plasma administered. It is not unlikely that the patient would have made satisfactory progress without any kind of transfusion, but today I would have ordered not more than a liter of blood, which represents that of two donors. This would effect a saving of 75 per cent in blood donor expense.

Less than 10 per cent of hospitalized patients will have so much injured tissue that there is local loss of plasma and a serious diminution in the amount of circulating blood. In an extreme situation, the extremities may be cold and no pulse can be felt at the wrist. The indication for treatment is clear; the blood volume should be augmented. There is a current feeling that whole blood is preferable to plasma, even though the hematocrit may be high. Furthermore, many severely burned patients

develop anemia in a week or two and the blood cells given early will be put to good use

The hematocrit may be taken as a rough guide to the amount of blood or plasma needed. Harkins' rule states that 100 cc of plasma should be given for each point the hematocrit is above the normal of 45. Usually, no replacement therapy is indicated unless the hematocrit values are above 60.

Fluid and Nutritional Requirements.—Oliguria is the rule in acute burns and need cause no concern during the first day or two. Usually the patient drinks fluid readily, but if there is vomiting or any other reason why an intake of at least 4000 cc is not obtained during the first day, the deficiency can be made up with parenteral 5 per cent glucose The use of physiologic saline solution may lead to the administration of an excess of the chloride ion, which will predispose to edema and may be a burden to the kidneys

Patient F. K. took 5260 cc. of fluid by mouth the first twenty-four hours and excreted 2050 cc. of urine Hence, it was unnecessary for him to have any supplemental intravenous therapy He was allowed to

review of the nurses' notes for the second day shows that the patient asked for and consumed the following, pineapple juice, 200 cc , orange juice, 200 cc., soup, 200 cc , ice cream, 150 cc ; milk, 200 cc , hot chocolate, 200 cc ; mixed fruit juice, 200 cc ; malted milk, 200 cc , eggnog, 200 cc , broth, 150 cc , milk, 200 cc , tea, 150 cc ; and water, 1200 cc Evidently he preferred a liquid diet because of his burned lips, but in many respects, the diet he selected would appear attractive to anyone Subsequent events showed that he did not suffer ill effects from being spared the ordeal of the alimentation of the various amino acid preparations and other synthetic mixtures which are more apt to produce nausea than any significant beneficial effect leading toward better healing of the thermal injuries.

On the eleventh day of the burn, the patient presented a rather unattractive appearance (Fig. 372, *A*). His beard had grown and was caked with dried plasma A few areas, especially around the right eye, were purulent However, the swelling had subsided nicely. The dressings on the hands and arms had been reinforced Otherwise, they were not disturbed until the eighteenth day, when they were carefully removed in the operating room under morphine sedation (Fig 372, *B*) The slough of the right upper arm was showing a tendency to separate spontaneously. It was obvious that the burn of the dorsum of the right hand was deep enough to involve tendons and joints. There were adherent sloughs on the left

hand. It was elected to begin grafting on the left hand and right upper arm. These areas were dressed with Dakin's solution for three days, with the result that the sloughs separated cleanly (Fig. 373, *A*). A culture of the wounds taken at the time of the first change of dressing was reported as containing a streptococcus and B. lactis aerogenes.

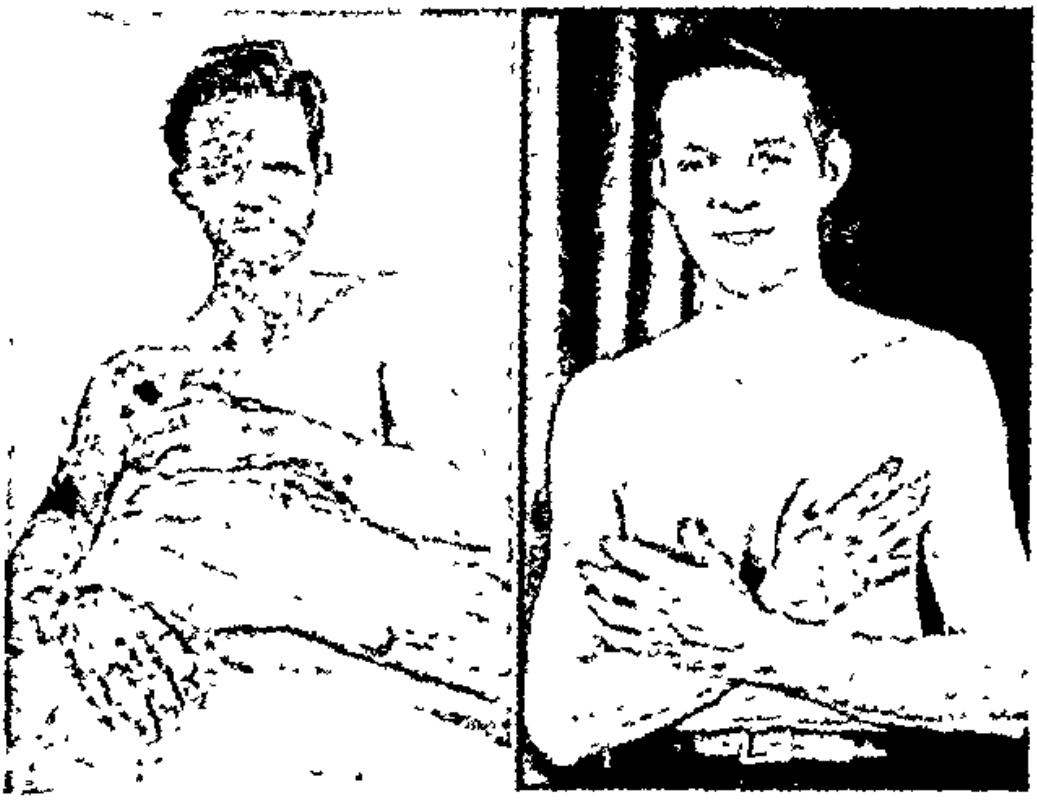
Skin Grafting Procedures.—The following skin grafting procedures were carried out. On April 28, twenty-four days after admission, dermatome grafts were applied to the left hand and forearm, the right shoulder and upper arm On May 3 dermatome grafts were put on the right hand.

A B

Fig 372 (Case I) —*A*, Eleventh day *B*, Situation at time of first dressing on eighteenth day The white areas on both hands represent sloughs which are adherent.

On May 24 Reverdin grafts were placed on various areas of the body. On May 26 further dermatome grafts were applied to the right hand, and at the same time the distal phalanx of the thumb and the distal two joints of the little finger were amputated. The terminal blood supply of these two digits had been compromised by the original severe burn. Good palmar skin was available for the stumps of the digits. At this operation, the dermatome grafts were laid on the medullary bone of the phalanges of several fingers, because the burn had been so deep that sequestration was taking place. On June 9 Reverdin grafts were placed on a few areas of the right hand.

From April 30 to May 29 he was given 12,500 units of penicillin intramuscularly every three hours. The object was to inhibit infection which might have complicated the skin grafting He was discharged from the hospital on June 20, two and a half months after the accident Subsequent follow-up revealed satisfactory cosmetic and functional results, with the exception of the right hand (Fig 373, *B*) Although the interphalangeal joints of this hand were ankylosed, the freely movable shortened thumb made the member surprisingly useful



A B

FIG 373 (Case I) —After three days of dakinization of left hand and right upper arm. The sloughs are ready to fall off *B* Final result, several months after discharge from hospital

EARLY SLOUGH REMOVAL

There is general agreement that the sooner areas of third degree burns are removed and the defects covered with split thickness grafts, the better For the accomplishment of this result, Connor and Harvey[12] have recommended the generous application of a starch paste containing pyruvic acid enough to give the mixture a pH of 1 9 They have presented convincing experimental and clinical results. However, it has been demonstrated that small third degree burns in the dog slough just as early with starch paste as with the pyruvic acid paste (Lam and Puppendahl[13]). The same result was obtained with plain tragacanth jelly and cotton wet

with distilled water. It was concluded that the favorable effect on sloughing seemed to be due to the wetness of the dressing rather than its acidity. The dry gangrene was converted to a wet one.

SURGICAL EXCISION AND IMMEDIATE GRAFTING OF FULL THICKNESS BURN WOUNDS

There is renewed interest in the surgical excision of full thickness burns and immediate grafting, as exemplified by the recent report of Cope and his associates at the Massachusetts General Hospital.[14] They reported on the expeditious treatment of fifty-two burns in thirty-eight patients. They found that when circumscribed burns of full thickness were excised and closed by grafting within a few hours of the injury, healing was gratifying. The longer the delay in closure, the greater was the infection, the less successful the take of grafts and the uglier and more disabling the scarring. A few days after I read this article on the excision of burned skin, a case was admitted which seemed to be a good one on which to carry out the procedure.

Case II.—J. F., a white man 65 years of age, was admitted on February 12, 1947. As a result of a spell of unconsciousness, he lay for an unknown time against a steam radiator and suffered a severe burn of a large area of his back. He entered the Henry Ford Hospital the day after the injury. Inspection revealed a well-circumscribed full thickness burn extending from the left scapular region to the level of the crest of the ilium (Fig. 374, *A*). The area was brownish-yellow in color and hard in consistency. The decision was made to excise the large area and cover the exposed tissue with split thickness grafts. However, some of the medical aspects of the patient were precarious and it was deemed inadvisable to give a general anesthetic until February 17, six days after the injury. The operation was accompanied by a considerable loss of blood and a liter was replaced while the patient was on the table. Much of the exposed tissues presented a poor base for the reception of a graft. It was obvious that the burn involved the muscles and tendinous structures of the back and débridement down to perfectly healthy tissue was out of the question. Nevertheless, the entire area was covered with dermatome grafts with the hope that a good percentage of them would take.

At the first dressing, five days after the grafting, it was found that not a square centimeter of the grafts had become attached. We were confronted with a huge open wound, in the middle of which could be seen some sloughing tendons of the spinal muscles and the tips of several spinous processes (Fig. 375, *A*). The wound was débrided daily and treated with Dakin's compresses, and four weeks later, on March 14, a second dermatome grafting was attempted. The entire area was covered, but only about 10 per cent of the grafts took. On April 9 a third dermatome grafting procedure resulted in a similar disappointment. In desperation, it was decided to apply Reverdin grafts and many grafts were placed on April 22, April 27, May 11 and May 14. The best results were obtained when the grafts

Henry Ford Hospital There were seven deaths, a mortality rate of 4.5 per cent. The fatal cases will be reviewed briefly, and examined critically to see if oversimplification of treatment was contributory to the poor results

CASE III.—G C., 62 years of age, was admitted on January 14, 1945, with flame burns of 50 per cent of the body surface The white blood cell count on the day of admission was 123,000, most of the cells being immature polymorphonuclear forms It was presumed that he had myeloid leukemia when he was burned Eight days later, the leukocyte count had risen to 232,350 The patient died two weeks after admission The only obvious cause of death was leukemia

CASE IV.—G R., a 41 year old ma[illegible] 5, after being t[illegible] s, hand[illegible] l whit[illegible] He exp[illegible] At no[illegible]

CASE [illegible] C., an 80 year old [illegible] tr[illegible] s[illegible] [illegible] given 500 cc of plasma, and t[illegible] given.

CASE VI.—L W., a 42 year old man, was admitted on M[illegible] 21, 1945, after being burned in an explo[illegible] for the prom[illegible] ice body [illegible] It was l[illegible] on admission He was given a token t[illegible] of plasma and expired eleven hours after admission.

CASE VII.—C R., a white woman 35 years of age, was admitted May 9, ten days after she received severe burns of the lower extremities After one stage of skin grafting, she developed tetanus and died suddenly with laryngospasm in spite of avertin and curare therapy She had received prophylactic tetanus antitoxin

CASE VIII.—R B., a colored man 57 years of age, was admitted January 16, 1947, with burns of the trunk and left leg He had syphilis and arterial hypertension, the blood pressure being 208/102 Eleven days after admission, he developed left hemiplegia and unconsciousness and expired three days later

CASE IX.—F K., a 60 year old man, was burned in a chemical explosion The entire body with the exception of the feet was severely burned As a gesture, he

was given 500 cc. of plasma and 1500 cc of blood. He expired five hours after admission

The causes of death in the seven fatal cases may be summarized as follows Two patients died of medical diseases (leukemia and cerebral hemorrhage). One patient died of tetanus, a disease not peculiar to burns and notorious because of its unpredictable nature and frequent refractoriness to treatment. Four patients with burns exceeding 75 per cent of the body surface died in a matter of hours. At no time was there the slightest hope that they would recover, because of the magnitude of their injuries.

SUMMARY

The present status of the treatment of burns may be said to be satisfactory, since a relatively simple plan of therapy is rewarded by gratifying results. It is recommended that the burned skin be covered with occlusive dressings, omitting any special local medication. Blood volume replacement is needed in less than 10 per cent of hospitalized patients; it is rarely if ever an emergency procedure and the present trend is toward the use of whole blood rather than plasma. The grafting of third degree burns should be begun by the end of three weeks, although in selected cases slough separation may be facilitated by wet dressings and, more rarely, a circumscribed area of full thickness burn may be excised and grafted immediately

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THE MANAGEMENT OF THE PULMONARY "COIN" LESION

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A little more than a decade ago Graham and Singer[1] reported three patients whom they had seen with rounded masses in the lung parenchymas which simulated tumors. Pathologic examination of these masses still left the diagnosis uncertain. They were apparently infectious in origin However, they had been rightly removed with the thought that they might well be malignant tumors

Today, when chest x-ray studies of large groups are being conducted and numerous peculiar and confusing rounded lesions are being discovered, the wisdom of this early communication becomes the more significant. These authors were the first to point out the possibilities of such lesions being malignant With boldness, in a day when pulmonary resection was not the safe procedure it is now, they removed the tumor containing lobes with gratifying results Since that day many rounded parenchymal masses within the lung have been treated conservatively by watching, only to find too late that the tumor mass, while it may not have increased appreciably in size, had metastasized widely and thus cost the patient his life. It is the function of this paper to bring forth once more the inherent dangers in conservative management of such lesions

Rounded tumors which appear in the lung parenchyma may be of four types from the standpoint of etiology. They are, namely: (1) malignant or benign tumors, (2) tuberculomas, (3) chronic indolent abscesses, or (4) metastatic tumors The latter will not be discussed here, because the previous history will usually disclose the nature of the tumor

MATERIAL

This study is based upon our experience with twenty-one patients observed in the last two and one-half years. In no instance was the

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patient whose tumor was inoperable is now dead. The patient whose lesion was a sarcoma is also dead. She died nine months after operation from rupture of a congenital aneurysm of the middle meningeal artery. A complete autopsy revealed no evidence of metastatic sarcoma or of local recurrence. The remainder of the patients are well from one month to two and one-half years after operation.

It becomes evident from the material and the results of the pathologic studies that rounded tumor masses within the lung are not safe lesions to treat expectantly. It is with this idea that the symptoms, clinical diagnosis and x-ray diagnosis will be discussed.

SYMPTOMS

The symptoms of such lesions are often minimal and in numerous instances the pulmonary lesion is discovered in the course of either a mass pulmonary roentgen survey, a casual fluoroscopic examination of the chest in the course of a gastrointestinal x-ray study, or a routine chest x-ray made as part of a general physical examination. Symptoms when present may be cough, hemoptysis, fever of unexplained origin, and/or the raising of small amounts of sputum.

Six of the twenty-one patients, or 28 9 per cent of the group, had no symptoms The pulmonary lesion was discovered in the course of a routine x-ray study of the chest. In two other patients, who had symptoms, the discovery of the lesion was also accidental. The story of symptoms was elicited later. One patient revealed the presence of hemoptysis over a period of several months and the other admitted to a bothersome cough

In those two patients whose presenting symptom was pain it was later shown that the pain was probably not related to the tumor mass at all In one the pain was most probably coronary in origin and in the other it appeared to be due to an intercostal neuritis. In neither instance was the pain on the side of the discovered tumor. Thus it becomes evident that actually in ten of the twenty-one patients there was no symptom actually related to the tumor mass.

Cough appears to be the commonest symptom. There is nothing characteristic about it except that in no instance was it severe.

Hemoptysis was present in four patients and in only one of these was a large amount of blood raised. It was usually characterized by the constant raising of small to minute amounts or streaking.

It is the scarcity of symptoms in these individuals that in many instances lulls the physician who first sees them into a false sense of security.

Previously we have mentioned that the tuberculomas appear by x-ray to be more sharply circumscribed This is not always true, however Reference is made to the reproductions of the x-rays of two patients only recently seen (Figs 380, 381, 382 and 383) It will be seen that the lesion in both these individuals was well rounded and discreet The tissue examination showed the one patient represented by Figure 379 to have a squamous cell carcinoma while that pictured in Figure 382 was a tuberculoma

FIG 379— This is the film of the chest made on M H ten days after the removal of the right upper lobe The lower and middle lobes have expanded to fill the pleural space

We have become increasingly less eager to make a definite diagnosis by x-ray in these patients, for too often we have found that our preoperative diagnosis was not borne out by the microscopic examination

DIAGNOSIS

When confronted with such a pulmonary lesion a physician should make use of certain diagnostic aids X-rays in both the posterior-anterior and lateral projections should be made to localize as well as possible the tumor mass Either overexposed or fast Bucky films should be made to establish the presence of calcified areas within the tumor mass.

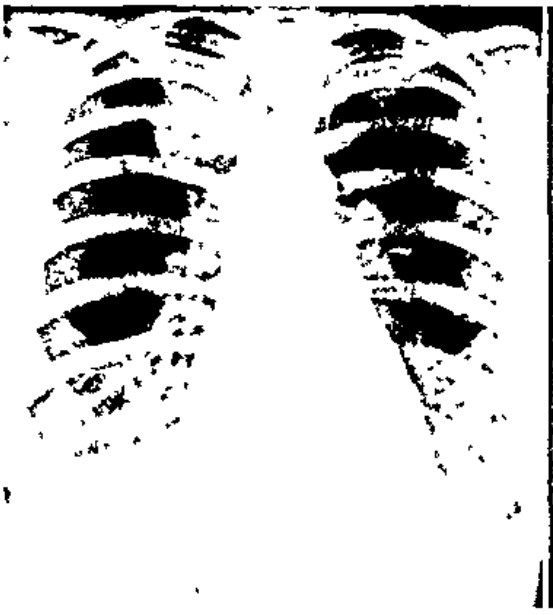

Fig 380

Fig 381

Fig 380.—X-ray of the chest of M L, a 35 year old white woman. The discovery was made on a routine film The microscopic diagnosis was squamous cell carcinoma

Fig 381 —Five days after a right upper and middle lobe lobectomy

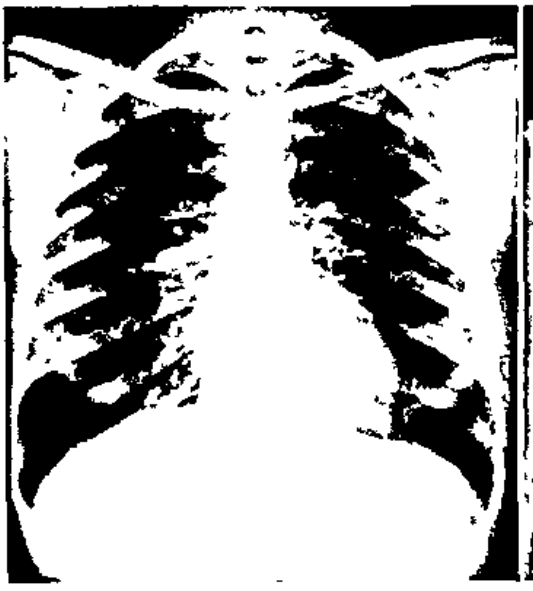

Fig. 382.

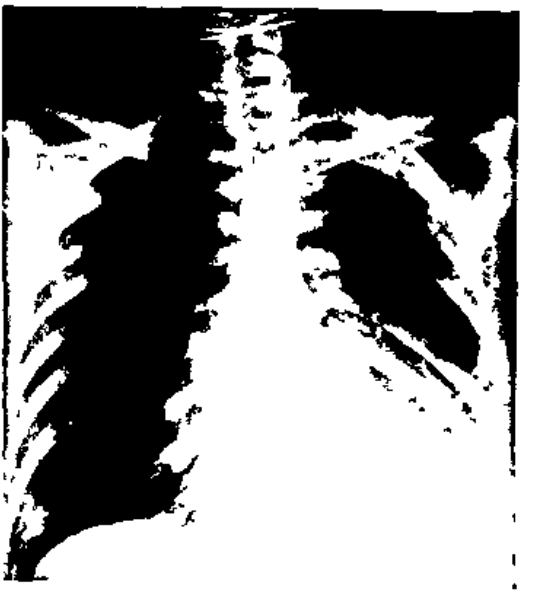

Fig 383

Fig. 382.—Rounded mass in the left upper lobe of the lung of a 27 year old white woman There is a small area of breaking down at the center The lesion was a tuberculoma Note the similarity to the lesion in Figure 380

Fig. 383 —Postoperative appearance of the chest of C. L represented in Figure 382 Note good expansion of the lower lobe to fill the pleural space

The sputum should be studied for tubercle bacilli. As a rule, routine smear studies of the sputum are negative for such organisms, but concentrated pooled specimens or gastric washing specimens may reveal

extensive previous tuberculosis in which the scar resembles a "coin" lesion. These patients should be considered separately. We believe emphatically that any new "coin" lesion with relatively clear parenchyma surrounding it should be removed. This applies also to single circumscribed lesions which are probably metastatic sarcomas from previously known extrapulmonary lesions of the same character.

CONCLUSIONS

Twenty-one rounded pulmonary parenchymal lesions which have been treated by pulmonary resection have been presented. Their diagnosis has been discussed. Eight of these masses were bronchogenic carcinomas; one was a sarcoma, and one was a chondroma. The remainder were tuberculomas, pulmonary abscesses, or cysts. The high instance of malignancy and the inadequacy of diagnostic means to differentiate these lesions brings the authors to the conclusion that in the interest of the patient's well-being and of good medicine such lesions should be treated by pulmonary resection.

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PRIMARY TENDON REPAIR

JOSEPH L. POSCH, M.D.

DESPITE the fact that at the Detroit Receiving Hospital large numbers of patients with injuries to the hands are seen yearly, prior to 1938 there was no organized effort toward their study or care. Although this state of affairs was not uncommon in the average general hospital, it would not seem to contribute in a progressive way to the best care of these patients. Treatment of hand injuries was usually considered a chore and delegated to the most inexperienced house officers. The results of such an arrangement were generally poor, as might have been expected In order to correct this deficiency in the care of injuries to the hand, a Hand Clinic was organized and the most experienced of the house officers were assigned the responsibility under the general supervision of a member of the staff. During the organization of the Clinic not only was helpful advice given by Drs. Sumner L. Koch and Michael L. Mason, but they also assisted by giving a period of instruction to these senior house officers. During the first four years following its organization, the Clinic was under the direction of Drs. Richard E. Speirs and Harry Miller, the results of their studies have been published.[1] [2] During the period from 1942 to 1946 the activities of the Hand Clinic were abandoned since practically the entire staff entered the military service and the hospital was markedly understaffed. In 1946, the Clinic was reorganized It has been the general policy in the Clinic that the cases are supervised by competent and interested individuals. The entire house staff participates in its activities, not only by assisting in follow-up care but also in relation to operative procedures. In this way these injuries are considered by the entire staff and the principles underlying their care are well considered.

It is well for us to emphasize the important contributions which Dr. Koch and his associates have made not only in relation to the problem in general, but also in the matter of initiating most of the concepts carried on by our Clinic. Since they have contributed so generously to the development of our program, it goes without saying that, for the most part, we follow the principles as outlined by Koch and his associates [3] [4] [5] [6, 7, 8]

This report is concerned with a consideration of the cases of injuries

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former method of suture, using fine cotton and the method described by Mason and Allen [11]

Since the majority of our cases have been relatively clean, there has not been a tendency for wide débridement. Great care is exercised to preserve all the tissue in the hand that is possible. In cases where wide débridement seems imperative if the tendon is to be sutured, we prefer to close the wound without suturing of the tendon rather than run the risk of excessive loss of tissue or infection in the tendon repair.

In regard to anesthesia, three types were employed—local infiltration, brachial block and general anesthesia. The latter is the preferred one. However, in the majority of the cases brachial or local block anesthesia was used because not infrequently the patient was admitted in an alcoholic condition, or there were other considerations which indicated to the anesthetist that general anesthesia was not the anesthesia of choice. There were no anesthetic complications seen except in two cases where block anesthesia was used. In one case it was thought that the pleura might have been entered since the patient had severe chest pain,

TABLE 2

Local anesthesia (mainly for extensor tendons)	112
Brachial block (mainly for flexor tendons)	33
Brachial block supplemented by general anesthesia	4
General anesthesia	16

but this was found not to be so. One other patient had a mild novocain reaction as evidenced by a fainting spell, but recovered promptly. The anesthesia which was used in these cases is listed in Table 2.

A tourniquet in the form of a blood pressure cuff, inflated to 250 mm of mercury, is used to insure a bloodless field. If the operation is prolonged the pressure is relieved from the blood pressure cuff at least every one and one-half hours in order to reestablish circulation for a few minutes.

Following the operation, the hand is splinted in the position best suited to relax the severed tendon, and a pressure dressing is applied. In general, the majority of these patients, unless there were other complicating lesions, were sent home to return to the Hand Clinic for subsequent care. Unless there was an impelling reason to do otherwise, the dressing was not changed for ten to fourteen days. It so happens that in this series there were but eleven instances in which the dressing required attention before the usual ten to fourteen days.

By and large we do not prescribe special physiotherapeutic measures other than those which the patient himself can carry out. In instances

where physiotherapy has been required, we have felt that this has been an indication of failure either on the part of the patient to carry out instructions, or on the part of the surgeon to instruct him properly in exercises of movement

Flexor Tendons.—It will be noted in Table 1 that the majority of our cases of severance of tendons have been found in the flexors of the fingers. No other injury requires more careful adherence to good surgical principles than does the repair of a severed flexor tendon. Many authorities state that after one to two hours a primary repair should not be done.[8,10] Others are so pessimistic that they suggest that if only the flexor digitorum profundus tendon is served it is to be left alone. Cootes[11] states that "If both tendons are involved, the hopeless prognosis should be told to the patient and amputation considered in relation to economical and occupational conditions." Kanavel[3] has made the statement that he would rather have the average surgeon operate upon him for acute appendicitis than for repair of a divided flexor tendon. Bailey[12] further states "Where a flexor tendon within its digital sheath has been cut the conclusion reached by one of us, who has had twenty-five years of experience in a city in which the local trades predispose to such injuries, coincides exactly with that of Teece who writes 'In our experience of several hundreds of cases of tendon injuries, I have never seen a case of successful primary or secondary suture when the point of division has actually been within the flexor sheath.' "

The results of primary suture of flexor tendons in general have been poor. This is no doubt due to the fact that hand surgery is perhaps one of the most neglected of all fields. Not only is the importance of injuries in the hand not properly appreciated generally, but interest in this field is not widespread. It is possible that the lack of general interest in injuries of the hand stems from the fact that the public is not likely to consider the problem important until a bad result ensues because the wound is usually not an impressive one and seldom causes death. Furthermore, the surgery of the hand requires arduous and careful work, and not only is an understanding of the principles of surgery required, but a knowledge of anatomy is essential.

During the year 1947 there were thirty-two cases of primary tendon sutures within the flexor tendon sheaths at the Detroit Receiving Hospital. We have careful follow-up studies on twenty-six of the thirty-two cases, and in these twenty-six cases, twenty obtained good to excellent results. One of these was complicated by compound fractures of the phalanx. In some cases a good functional result was obtained but the patient could not flex the distal phalanx when the fingers were in the palm These were considered good results. There was minimal infection

in two of these thirty-two cases, but this did not affect the function Of the remaining, a poor result was obtained in six patients despite the fact that these did not become infected

With lacerations in the tendon sheath it has been our policy to suture only one of the tendons, the profundus, and to remove the sublimus This is not cut too long so that it attaches to the profundus, or too short so that it allows hyperextension of the proximal interphalangeal joint. The sheath is left open over the suture. Actually it should be possible to obtain and maintain anatomical approximation of both of these tendons within the tendon sheath, but on the basis of experience and teaching of others, we have hesitated to do this Poyner[13] recommends the suturing of both tendons within the tendon sheath and we see no reason why good results should not be obtained if the operation is carefully done

Incisions for obtaining better exposure are made in the sides of the finger in the anterolateral aspect, avoiding the digital nerve and vessels The midline incision is avoided In one case the incision was made too far toward the midline and a moderately severe contracture did occur Although the patient does have good flexion, extension is difficult.

No 60 cotton was used as suture material in all of the cases The type of suture advocated by Mason and Allen[14] was the one most commonly used A small bundle of tendon fibers is caught about 2 cm from the end of the tendon and a knot is tied. The end is tagged with a mosquito hemostat Then the suture is run directly through the tendon to the other side; another bundle of fibers is caught on the other side. The loop is left long and cut. A knot is then tied and the suture fastened and the other side is then brought out over this The suture attached to the knot is then run back through the tendon and out over the previously tied knot on the other side. The previously clamped suture is then cut The same procedure is followed on the other tendon. The ends are tied and the tendon ends approximated. Interrupted cotton sutures are used to approximate accurately the tendon ends These are placed in the peritendinous tissue. By this type of suture a longitudinal pull is converted into a transverse one. The substance of the tendon is not injured more than is absolutely necessary and there are no knots between the tendon ends. This suture actually takes up the tension and permits approximation of the severed ends of the tendon by interrupted suture.

We have repaired several cases by the use of pull-out wires as advocated by Bunnell;[9] despite the fact that in these cases satisfactory results were obtained, the difficulty in removing the wires and the troubles associated with their use indicated abandonment of this procedure. In a series of cases treated several years ago in our clinic, buried wire suture was used and this was found to be exceedingly troublesome

While the pull-out wire as advocated by Bunnell gives results much better than the ordinary buried wire suture, in our estimation it has many of the drawbacks and does not appear to be as clean-cut a surgical procedure as the use of cotton. Accordingly our experience with the pull-out wire has led us to abandon its use.

Flexors of the Fingers.

CASE I —T. B , an 8 year old white boy, was admitted on July 11, 1947, with a history of suffering from a cut on his right little finger when he fell on a piece of glass. Examination revealed a transverse laceration of the proximal interphalangeal crease of the right little finger. The flexor digitorum sublimis was intact but the flexor digitorum profundus was severed. There was no sensory loss. The patient was given 1500 units of tetanus antitoxin, morphine gr 1/8 and atropine sulfate gr 1/200. He was taken to the operating room, and under general anesthesia the hand and forearm were thoroughly scrubbed for ten minutes A blood pressure cuff was applied and used as a tourniquet. A medial distal and proximal lateral incision was made to enlarge the previous laceration and the severed ends of the tendon were identified. These were approximated with No. 60 cotton The blood pressure cuff was removed Hemostasis was secured by clamping and ligating the bleeding vessels with cotton. The wound was closed with interrupted sutures of fine cotton. Dry sterile dressings were applied and a posterior plaster mold with the finger and wrist in moderate flexion was applied. The patient was admitted to the hospital for two days and then discharged Sutures were removed two weeks after injury. One month after injury it was noted that the patient had a small amount of pus at the distal crease. Hot soaks were advised and this cleared up uneventfully. About six weeks after injury the patient had good motion of the deep tendon. The patient now has excellent function of his right little finger (Fig. 384).

CASE II —I D., a 33 year old colored woman, was admitted to the hospital on May 20, 1947, with a history of suffering from multiple lacerations of her right hand. She had been drinking a good deal Examination revealed transverse lacerations of the flexor surface of each of the fingers of the right hand; the little finger had been lacerated at the proximal interphalangeal crease, the ring finger over the middle phalanx, and the middle and index fingers at the distal interphalangeal crease. Examination revealed the deep flexor tendons to the index, middle and little fingers had been severed, and in addition the digital nerves to the little and index fingers had been severed Because of the patient's alcoholic condition it was decided to obtain anesthesia by means of a brachial block. This was done, employing 2 per cent metycaine. Near the end of the procedure this block had to be supplemented with nitrous oxide. The entire right hand and forearm were thoroughly prepared with soap and water. A blood pressure cuff was applied to the upper arm. The arm was elevated by the finger tips for fifty to sixty seconds and the blood pressure cuff was inflated to 250 to 300 mm. of

mercury. Sterile dressings were applied Examination of the little finger revealed that the flexor digitorum profundus was severed just opposite the sublimus tendon The original incision then extended along the ulnar aspect of the little finger so that adequate exposure could be obtained The proximal portion of the tendon was then readily found. By means of the Mason method of suturing, the tendon ends were approximated, using No 60 cotton The digital nerves were approximated, using 5-0 silk The severed tendon of the middle finger was repaired by the same method, the tendon and nerves of the index finger were reunited in the same way The skin edges were approximated with No 60 interrupted cotton sutures At the end of one and one-half hours the blood pressure cuff was released and pressure with moist sponges was applied to the operative

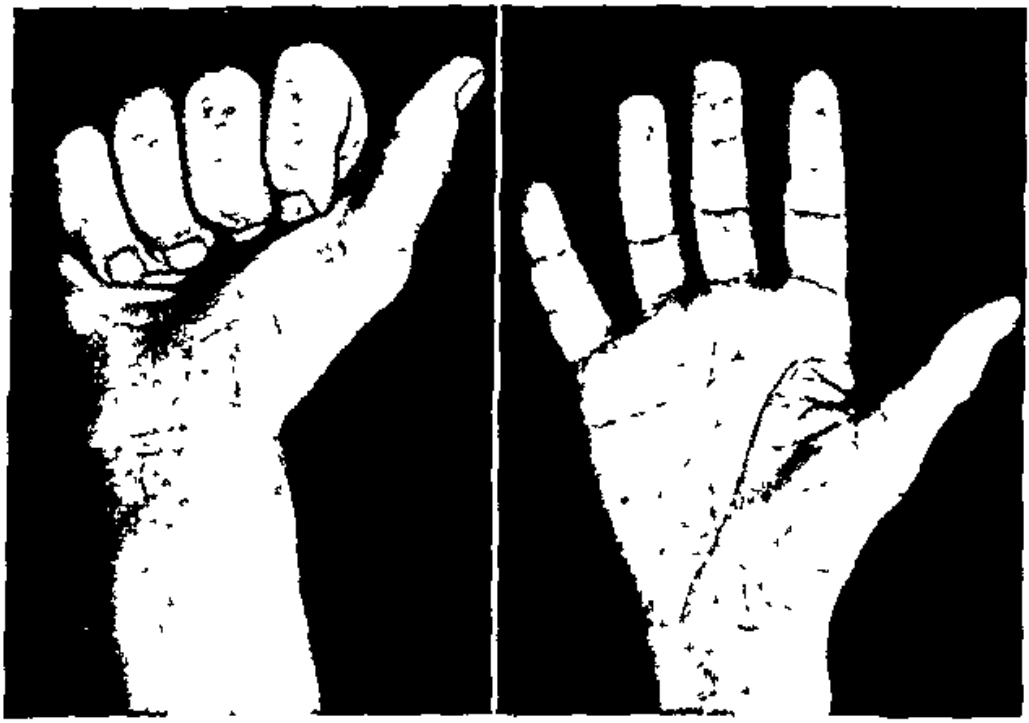

FIG 384 (Case I) —Laceration of flexor digitorum profundus tendon of right little finger Primary suture with excellent result

site for five minutes At the end of this time, bleeding vessels were clamped and ligated; the arm was then elevated, the blood pressure cuff inflated again, and the tourniquet kept on until the end of the procedure. Dry sterile dressings were applied and the hand was then dressed in moderate flexion A posterior plaster mold was applied, extending from the middle third of the forearm to the distal phalanges The entire procedure lasted three hours

The patient was discharged from the hospital the next day and followed in the Hand Clinic There was no sign of infection so the cast was kept on for ten days At the end of that time it was removed and the sutures were taken out The hand was then replaced in the posterior mold and kept in flexion The patient was encouraged to move the distal phalanges as far as possible even with the hand in flexion. At the end of three weeks the patient was allowed to bathe the hand in

warm, soapy water three times a day and start passive motion. At the end of four weeks this was increased to active motion. At the present time the patient has good function of all of the involved fingers and sensation has returned in the involved areas (Fig 385).

CASE III.—P N., a 49 year old white woman, was admitted to the hospital on May 18, 1947, with a history of lacerating her right hand on a coffee can. Examination revealed lacerations across the flexor surface of the middle phalanx of the fifth and middle fingers. The profundus tendon had been severed in each. A dry sterile dressing was applied The patient was given 1500 units of tetanus antitoxin

FIG 385 (Case II) —Lacerations of little, middle and index fingers with severance of flexor digitorum profundus tendon. Primary suture with a good result.

and removed to the operating room Under general anesthesia a primary tenorrhapy was done. This operative procedure began about four hours after injury was sustained The right hand and wrist were thoroughly prepared with soap and water for ten minutes A blood pressure cuff was applied for hemostasis. The lacerations were irrigated and explored A midlateral incision was made along the involved fingers to visualize better the structure In the middle finger, the profundus tendon was severed but had not retracted and the sublimis was only partially cut. Both were re-approximated In the fifth finger the profundus tendon had retracted and a transverse incision in the palm was made to find the proximal end. The sublimis tendon was then removed and the profundus tendon re-approximated No 60 cotton was used throughout. It was also found that the distal nerve to the radial side of the middle finger had been severed, but after search it

was found impossible to suture the nerve properly and the attempt was discontinued Following closure of the wounds, sterile dressing was applied and the hand was placed in moderate flexion

replaced with a metal splint Twelve days after injury all sutures were removed

Fig 386 (Case III) —Laceration of middle finger and little finger There was partial

The patient was advised to continue with the soaks and to begin active and

completely into the palm The patient can use the hand for washing and all household duties However, she does state that cold weather bothers her fingers (Fig 386).

Flexor Pollicis Longus —In 1947 there were thirteen cases of injury to the flexor pollicis longus. This includes only those in which the tendon itself was injured There were other cases of severe lacerations of the

wrists where the flexor pollicis longus was involved with other structures. There were no instances of infection in this group. Follow-up was not complete in one; as for the others, eight have obtained excellent motion. and four have good to fair motion One patient has almost complete range of motion but the tendon bow-strings. However, the patient refuses further surgery since he feels the function is good enough. In practically all instances it was necessary to make another incision over the proximal portion of the flexor pollicis longus in the wrist to identify it. This was then brought over through the tendon tunnel. In none of these cases to date has it been felt necessary to do a secondary tenorrhaphy since primary union was obtained.

Case IV.—A. T , a 23 year old colored woman, was admitted to the hospital on September 10, 1947, suffering from multiple stab wounds of the face, abdomen and right hand. She was in severe shock. She was given transfusions of whole blood in the Admitting Ward She recovered from the shock and was taken to the operating room where multiple lacerations were sutured. Exploratory laparotomy revealed perforation of the stomach along the greater curvature. This was sutured The wound in the thumb was examined and the laceration was at the metacarpophalangeal joint. This extended completely around the base of the thumb. The distal end of the flexor pollicis longus was readily found but it was necessary to make an incision in the wrist in order to locate the proximal portion of the tendon. It was found, sutures were placed in it and it was delivered through the sheath and united with the distal fragment. A Mason type of suture, employing cotton, was used The skin edges were united with interrupted cotton. The thumb and wrist were dressed in acute flexion. Because of her other injuries, the patient was kept in the hospital for thirteen days. During this time she received 5,886,000 units of penicillin. She was discharged and followed in the Hand Clinic. At the end of fourteen days the splint was removed and the sutures taken out. The patient was kept in a posterior plaster mold for three weeks; it was then removed and active and passive motion were then encouraged. The motion was slow in returning to the distal phalanx. However, continued exercises and warm hand baths at home resulted in excellent range of motion within three months (Fig 387).

Laceration of Tendons in the Palm —There were nine cases of lacerated tendons in the palm No infection occurred in any of these. In three cases excellent results were obtained, and there were four poor results. Follow-up was incomplete in two cases. One patient has 15 per cent motion of the metacarpophalangeal joint and another has 15 per cent motion at the interphalangeal joint. One patient had secondary tenorrhaphy elsewhere and one of the others should have secondary tenorrhaphy.

Case V —A. S , a 44 year old colored woman, was admitted to the hospital on April 6, 1947, suffering a laceration of the palm over the middle flexion crease,

caused by broken glass. Examination revealed inability to flex the right middle finger. Sensation was intact. A dry sterile dressing was applied. The patient was given 1500 units of tetanus antitoxin and taken to the operating room. The right hand and forearm were thoroughly prepared with soap and water for ten minutes. Anesthesia was obtained by means of 1 per cent novocain infiltrated locally. The laceration was explored and the skin incision extended proximally and distally. The severed proximal and distal ends of the resected flexor digitorum sublimus and flexor digitorum profundus tendons were identified and were individually re-approximated, using interrupted cotton sutures. The operative site was

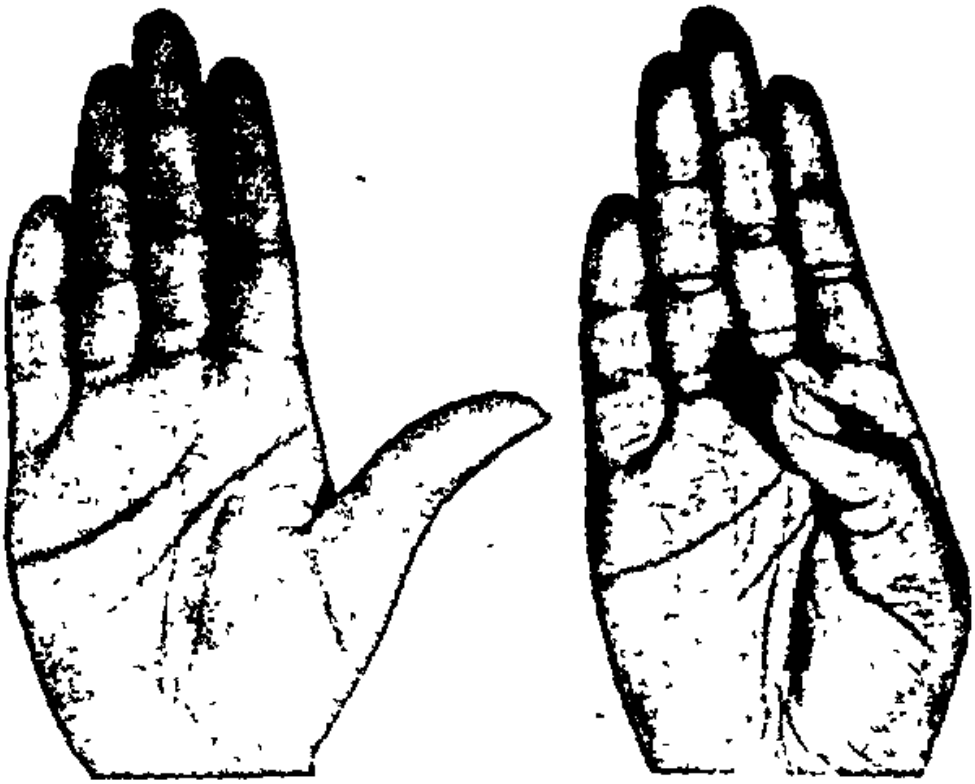

Fig. 387 (Case IV).—Lacerated flexor pollicus longus with primary suture. Result six months after injury.

thoroughly irrigated with normal saline solution. The synovial sheath was united with interrupted sutures of fine cotton and skin and subcutaneous tissues were approximated with interrupted sutures of similar material. A dry sterile dressing and a posterior plaster mold with the fingers and wrist in moderate flexion was applied. Sutures were removed in twelve days and the wound was well healed. Nineteen days after injury the patient was instructed to begin active and passive motion gently and cocoa butter was given to rub into the injured area. The patient was seen twice a week in the next month. Range of motion gradually increased. Six weeks after injury, the patient was able to flex fingers almost the full amount. She continued with active and passive motion, and the result is shown in Figure 388, taken ten months after injury.

Flexor Tendons at the Wrist.—There were forty-three cases of lacerated flexor tendons in the wrist. Of this number, one tendon was involved, either the flexor carpi ulnaris or flexor carpi radialis in sixteen cases, and the results in these cases were uniformly good. Complete follow-up was obtained in nine of these sixteen cases. In the remaining twenty-seven cases the flexors of the fingers were involved and usually there were multiple tendon injuries; in twenty-two cases there were associated nerve injuries. Twenty-five of these were followed. Excellent results

FIG. 388 (Case V).—Laceration of palm involving flexor digitorum profundus and sublimus to right middle finger and base. Primary suture done of both tendons. Photograph taken ten months after injury.

were obtained in twenty-two, and all of these cases ended with a poor result. There were three cases of infection.

CASE VI.—J. C., a 20 year old woman, was admitted to the hospital at 2:50 P.M. on December 2, 1947. She suffered a long laceration of the neck and also of the right wrist, severing structures on the volar aspect. She was given 1500 cc. of 5 per cent glucose in saline. A dry sterile dressing was applied to the wound. Fifteen hundred units of tetanus antitoxin was given and morphine sulfate gr. $\frac{1}{6}$ was given hypodermically. She was taken to the operating room where, under general anesthesia, the laceration of the neck which involved the trachea was repaired. The right hand and forearm were then thoroughly scrubbed for ten minutes with white soap and water. The laceration of the right wrist was irrigated

caused by broken glass. Examination revealed inability to flex the right middle finger. Sensation was intact. A dry sterile dressing was applied. The patient was given 1500 units of tetanus antitoxin and taken to the operating room. The right hand and forearm were thoroughly prepared with soap and water for ten minutes. Anesthesia was obtained by means of 1 per cent novocain infiltrated locally. The laceration was explored and the skin incision extended proximally and distally. The severed proximal and distal ends of the resected flexor digitorum sublimus and flexor digitorum profundus tendons were identified and were individually re-approximated, using interrupted cotton sutures. The operative site was

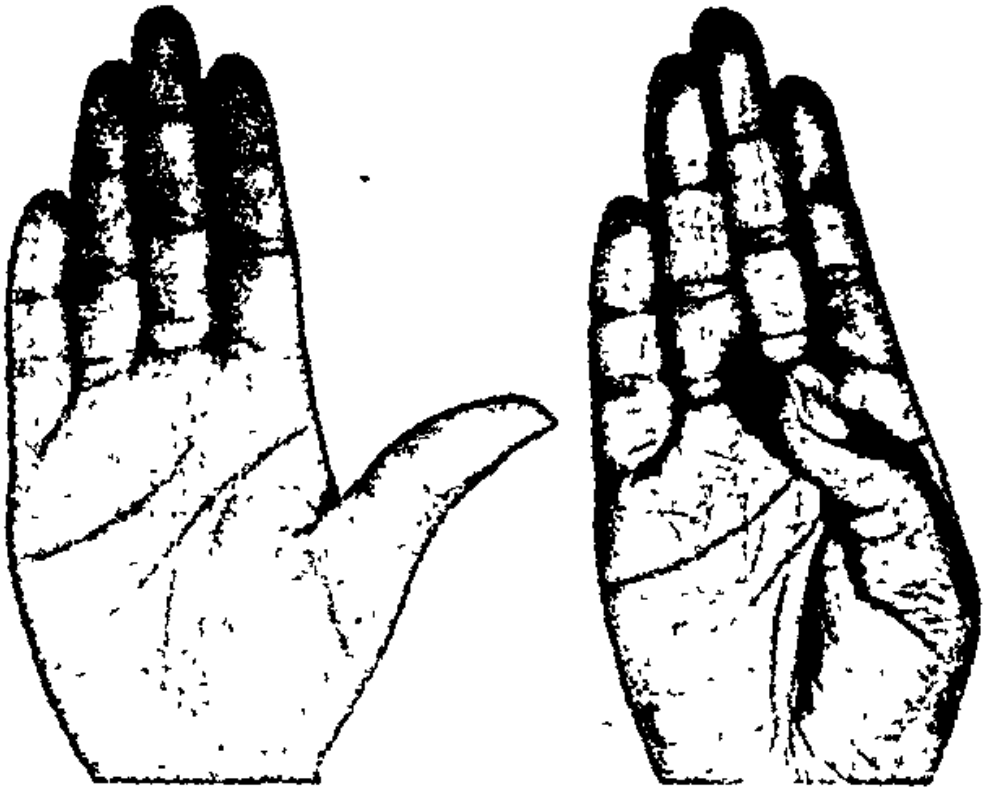

FIG. 387 (Case IV).—Lacerated flexor pollicus longus with primary suture. Result six months after injury.

thoroughly irrigated with normal saline solution. The synovial sheath was united with interrupted sutures of fine cotton and skin and subcutaneous tissues were approximated with interrupted sutures of similar material. A dry sterile dressing and a posterior plaster mold with the fingers and wrist in moderate flexion was applied. Sutures were removed in twelve days and the wound was well healed. Nineteen days after injury the patient was instructed to begin active and passive motion gently and cocoa butter was given to rub into the injured area. The patient was seen twice a week in the next month. Range of motion gradually increased. Six weeks after injury, the patient was able to flex fingers almost the full amount. She continued with active and passive motion, and the result is shown in Figure 388, taken ten months after injury.

in the plaster mold, and the mold was removed at the end of twenty-one days The patient was encouraged to start active and passive motion gently for the first week by placing her hand in warm soapy water three times daily. At the end of four months she had good motion on flexing and extending the wrist, good flexion of all fingers, but inability to extend them completely. It was considered that to date a good result was obtained (Fig. 389).

Extensor Tendons.—It is a well-known fact that lacerations of the extensor tendons yield better results than the flexors. Frequently the concept is gained that good results will follow regardless of how these lacerations are treated. This is certainly not true. While severance of the extensor tendons is not so difficult a problem as is the case in severance of a flexor tendon, it still requires careful consideration. In our series there were eighty-four cases of severed extensor tendons. Infection occurred in four cases out of sixty-three which were followed for a period of time sufficient to determine this point. Complete follow-up studies were obtained in fifty-seven cases. There were excellent to good results in fifty-one of these fifty-seven cases. Six of the cases required either tenorrhaphy or secondary repair. The following is a report of one of these cases which illustrates the difficulties which one may encounter even in the case of extensor tendons

CASE VII.—A E, a 40 year old man, was admitted to the hospital on December 24, 1947, at 11:40 P.M. He was suffering from a laceration of his left hand Examination revealed a long oblique laceration on the dorsum of the left hand with inability to extend the ring and middle fingers. The laceration extended from near the base of the little finger towards the base of the thumb. The patient was taken to the operating room and repair was begun about five hours after injury. The hand was thoroughly scrubbed with white soap and water and anesthesia was obtained by means of 1 per cent novocain. The ends of the tendons were identified. The wound was thoroughly irrigated with normal saline The injured tendons were débrided and the ends approximated with cotton suture. Fat from the subcutaneous tissue was placed over the site of the union. The sutures were removed on the ninth day. There was no sign of infection. On the twenty-second postoperative day the splint was removed Moderate swelling was present. The patient was encouraged to begin early active and passive motion. He was followed in the Hand Clinic where exercises and motion were encouraged. However, at the end of four months, extension was good but the patient was unable to flex his fingers completely and needs a tendolysis.

Extensor Pollicis Longus.—Of the eighty-four injuries to the extensor tendons, ten involved the extensor pollicis longus. Injuries to the extensor pollicis longus cause more difficulties in care than do injuries of the other extensor tendons. Of the ten cases of injury to the extensor pollicis longus in our series, adequate follow-up study was obtained

in eight. In these eight cases, secondary tenorrhaphy was required in three, while an excellent primary result was obtained in five. In one case requiring secondary tenorrhaphy, the extensor radialis brevis was transplanted to the distal portion of the extensor pollicis longus, in another case the extensor digitorum communis was transplanted to the distal portion of the extensor pollicis longus The third patient refused tenorrhaphy. The proximal end of the extensor pollicis longus was not utilized in either of these cases because of the difficulty of obtaining approximation of this tendon, and simpler suture with the other structures seemed preferable. In both of these secondary tenorrhaphies good results were obtained In reviewing these two cases, it appears to us that the cause of failure for primary union could be ascribed to the fact that the extension splint was discarded at the end of three weeks. We usually keep the extension splint on for three weeks, after which it is applied for two more weeks at night. The patient is not likely to cause injury to an unsplinted extensor tendon during his waking hours after three weeks has elapsed However, during sleep, there is a possibility the patient will not be so careful about flexion Primary suture of the tendon was not done in one of the three cases because of difficulties encountered at the operation in finding the proximal end of the tendon

Case VIII.—L. C., a 47 year old white woman, was admitted to the hospital on April 24, 1947, suffering an injury to the dorsal aspect of her right thumb Examination revealed a laceration on the dorsal aspect of the right thumb at the metacarpophalangeal joint with severance of the extensor pollicis longus, abductor pollicis longus, and extensor pollicis brevis A dry sterile dressing was applied The patient was taken to the operating room and a brachial block was performed Adequate anesthesia was obtained The blood pressure cuff was applied and used as a tourniquet The entire hand was then thoroughly washed with white soap and water for ten minutes The respective proximal and distal ends of the severed ends were identified and united with interrupted cotton and silk sutures The blood pressure cuff was then released and hemostasis obtained The hand was immobilized with the thumb in complete abduction and extension, using an anterior mold The patient was discharged from the hospital the next day and followed in the Hand Clinic At the end of eight days the cast was removed and sutures taken out A plaster splint was then applied and the patient was kept in this for three weeks At the end of this time the splint was removed and the patient was advised to start active and passive motion gently She stated that although motion was present at first, one day she felt something give and all motion was lost since that time

On June 24, 1947, two months after the first injury, a secondary tenorrhaphy was performed Under nitrous oxide ether anesthesia, examination revealed that the abductor pollicis longus was intact as was the extensor pollicis brevis. The extensor pollicis longus was involved in a large mass of scar tissue over the meta-

carpophalangeal joint. The tendon was intact but was bound down by scar. Attempts were made to bring the extensor carpi radialis brevis down and unite it to the extensor pollicis longus. It was found that it was too short so the extensor digitorum communis from the index finger was taken as far distally as possible and then united to the extensor pollicis longus by means of a Mason type of suture. The extensor carpi radialis brevis was then re-sutured to its attachment at the base of the second and third metacarpals. Healing was uneventful However, this time the patient was kept in extension for almost five weeks. Extension was fair but the patient had trouble moving the distal phalanx. She was instructed to use warm soapy hand baths three times daily and to wear the splint at night only. At the end of two months she had a fair result.

COMMENT

Without doubt infection is the most common cause of difficulty in tendon repair. As has been seen from this report, the presence of mild infection does not preclude a good result in some instances, but as a general rule it does. Accordingly, exceedingly great care must be exercised to remove as many contaminating organisms from the wound as possible. Careless surgery, excessive trauma and the use of irritating solutions for cleansing the wounds are factors contributing to failure.

In addition, gross contamination of the wound at the time of injury predisposes to infection. While we have used penicillin intramuscularly in the majority of our patients who were admitted to the hospital, we do not feel that it can be relied upon too heavily to prevent infection in the wound in the absence of proper care. These patients were admitted to the hospital because of the association of other injuries or the fact that they had had anesthesia administered. In no cases have we instilled penicillin or chemotherapeutic agents in the wound itself since we feel that this is not only of no advantage, but is actually deleterious.

It is our opinion that primary tendon repair is an exceedingly important procedure and should be carried out as early as possible. If, however, the wound has been neglected for a period of time sufficient to preclude the possibility of obtaining primary suture in the absence of infection, the wound should be closed without suture of the tendon. Fortunately, during 1947 we have had but two cases at the Detroit Receiving Hospital which were seen too late to attempt primary suture. Both of these wounds were open wounds, one seen one week after the injury, the other twenty-four hours later. Wherever it is possible, without too much danger of infection, or where the patient's general condition precludes any type of definitive surgery, primary tendon suture should be carried out.

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ELECTIVE SURGERY IN THE AGED

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UNTIL recent years, little has been written about the surgery of the aged. Now the literature abounds with reports relative to their medical and surgical care. Yet little has been said about the choice of patients or about the alterations in the technics which are required by the special problems of advancing age. Members of the profession who are not in hospital practice are beginning to realize what advances have been made in the fields of anesthesia, nutrition and operative technics that are making possible operative correction of disease in people of all ages. Now, after careful study and preparation, almost any procedure can be carried out on some patients and some procedures on almost any patient

CLASSIFICATION AND EVALUATION

To give a definite background for a review of the surgery of the aged, we have undertaken a study of all of the patients over sixty-five years of age admitted to this Clinic during the past five years. We find that the surgical cases naturally fall into three groups. The first group comprises those cases requiring immediate operation as a life-saving measure. In the second group surgery is imperative. While it is true that in these the surgeon may choose the time of operation and may elect the type of intervention, nevertheless the disease will kill the patient unless an operative procedure is successful. The third group (Tables 1 and 2) consists of those cases in which operation is purely elective. The symptom which brings these patients to the clinic is a discomfort or inconvenience which, though it may be severe and even incapacitating, is nevertheless not one which will threaten their life expectancy.

We shall limit our discussion to the second and third groups, for it is in these cases that our efforts of preparation and evaluation should bring the greatest reward It is in these groups that the surgeon must not only use sound judgment concerning the patient's ability to withstand the burdens imposed upon his physiological reserve by an operative intervention, but also consider the philosophical implications, weighing the mortality percentages against life expectancy and the comfort of the patient without surgery. Shall the surgeon be radical in his

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TABLE 1

ELECTIVE MAJOR OPERATIONS

Type of Operation	Number of Operations		Per Cent
General Surgery			
Thyroidectomy nontoxic goiter	7		
Mastectomy, simple; benign	7		
Partial gastrectomy duodenal ulcer	1		
Vagotomy gastrojejunal ulcer	1		
Cholecystectomy	14		
Cholecystectomy and choledochostomy	5		
Laparotomy abdominal aneurysm	2		
Repair of hernia inguinal, femoral and ventral	63	100	19 6
Gynecology			
Vaginal hysterectomy	14		
Abdominal hysterectomy	3		
Vaginal repair and colpocleisis	9		
Interposition operation on uterus	3		
Excision of vulva	1	30	5.7
Orthopedic Surgery			
Open reduction, neck of femur	57		
Open reduction, trochanter (intertrochanteric), femur	70		
Open reduction, miscellaneous	21	148	29 1
Neurosurgery			
Obturator neurectomy	1		
Sympathectomy	1		
Chordotomy	1		
Laminectomy and rhizotomy	1	4	0 8
Eye, Ear, Nose and Throat Operations			
Enucleation of eye tumor and glaucoma	22		
Operations for cataract	202		
Miscellaneous	4	228	44 8
Total		510	100 0

eradication of a malignant growth or shall he temper his desire for a cure by increasing the chances for immediate survival of the operation? In the third group, the purely elective procedures, the problems become

even more complex. Here the surgeon is faced with the fact that the patient has a normal life expectancy, albeit with discomfort, and his operation must be attended with a low mortality rate and a maximum

TABLE 2

ELECTIVE MINOR OPERATIONS

Type of Operation	Number of Operations		Per Cent
Endoscopy peroral	14	14	6.1
General Surgery			
Excision of lesions of skin and skin graft	76		
Mediastinotomy (chest trauma)	1		
Diagnostic dilatation and curettage	4		
Ligation or injection of varicose veins	20		
Hemorrhoidectomy	19	120	52.4
Genitourinary Surgery			
Cauterization of urethral caruncle	6		
Aspiration and excision of hydrocele	10		
Circumcision	2	18	7.9
Orthopedic Surgery			
Bunionectomy, excision of cysts, etc	23		
Manipulation of joint arthritis	14	37	16.1
Neurosurgery			
Section of phrenic nerve	1		
Resection of trigeminal nerve	1		
Sympathetic block or nerve injection	11	13	5.7
Eye, Ear, Nose and Throat Operations			
Excision of chalazion	13		
Destruction of entropin	14	27	11.8
Total		229	100.0

degree of comfort. This applies to the patient whose reserve and physiological resilience are at a low ebb.

The evaluation of the problem begins with a study of the patient's background and psychological make-up. Too often the family history is

completely forgotten. It is important to know the stock from which this particular individual descends Is it of rugged, long-lived people? Did the mother rear eight or ten healthy children and die at the age of 80? Did the father plow his fields and raise his crops until almost 70 and then continue to oversee the work for another five or ten years? This information is just as important as the laboratory figures The mental state also assumes some importance, especially in the philosophical aspects of the situation

The first consideration in the study of the patient is no different in the aged than in the young—a complete review of the disease which brings the patient to the physician Its stage of advancement demands careful evaluation While it is probably true that carcinomas in old people are slower in their growth, yet the older patients present themselves for treatment far later than young and healthy individuals The families of the aged are accustomed to their complaints It is expected that age is almost synonymous with physical complaints It is also true that older people lose the ability to focalize their complaints, and too many of them come for medical help after all possibility of cure has passed It is therefore imperative that all possible extensions and complications of the present disease be understood and all diagnostic aids available be utilized in this study, lest the patient be subjected to a needless operation

Next in the study must come the search for associated diseases These must be found and receive careful consideration both as to degree and possibility of correction. All of the degenerative diseases must be considered As will be noted from Tables 3 and 4, a wide variety may exist Not only will these temper the choice of the operative procedure, and not only will their amelioration permit an otherwise impossible intervention, but also the knowledge of their presence will prevent complications during the postoperative period. For this reason it is our custom to require a most careful history and complete physical study of all patients Moreover, the laboratory studies of the blood sugar and blood urea nitrogen, blood Kahn test, complete morphological study of the blood, and repeated urinalysis are performed on all older patients. A stereoscopic x-ray film of the chest is done on every older patient. If there is any question concerning the cardiac status, electrocardiographic studies are carried out and the cardiac status is determined by the cardiologist

Certain degenerative processes are more or less evident in all older patients. These may not be noticeable on superficial examination, as the physiological compensation may be entirely adequate under normal activity. Yet the reserve may be lacking so that the trauma of anesthesia,

of the operation, or even the aberrations incident to the psychic trauma may throw the patient into a state of decompensation. One thinks first of the cardiac and renal reserves. These are especially low in those of advanced years. The former is most difficult to estimate and it requires much experience to judge whether the myocardium is capable of the

TABLE 3

ASSOCIATED CONDITIONS WITH ELECTIVE MAJOR OPERATIONS

Hernia	Vesicovaginal fistula
Peptic ulcer	Compensated heart disease
Gastrointestinal hemorrhage	Cardiac decompensation
Peritoneal adhesions	Gangrene, peripheral
Secondary appendectomy	*Thrombophlebitis*
Hemorrhoids	Anemia
Cholecystoduodenal fistula	Pneumonia
Cholelithiasis	Associated fracture and lacerations
Carcinoma of kidney	Residual poliomyelitis
Pyelonephritis	Paralysis agitans
Chronic nephritis	Residual cerebrovascular accident
Cystitis	Psychosis
Urethrocele	Metastases
Hypertrophy of prostate	Diabetes mellitus
Carcinoma of prostate	Myxedema
Hydrocele	*Arthritis*
Fibroid of uterus	Paget's disease (bone)
Cystocele, rectocele	Carcinoma of cheek

TABLE 4

ASSOCIATED CONDITIONS WITH ELECTIVE MINOR OPERATIONS

Hernia	Anemia
Diverticulum of esophagus	Carcinoma of lung
Diverticulosis of colon	Associated fracture
Hemorrhoids	Psychosis
Cholecystitis	Metastases
Compensated heart disease	Hodgkin's disease
Cardiac decompensation	Diabetes mellitus
Arterial embolus	Arthritis

added effort. There are no machines and no laboratory figures that will answer the question The absence of the signs of decompensation and the ability to hold one's breath for a reasonable period afford some reassurance. Yet the decision rests with clinical judgment born of mature experience

The renal reserve is more amenable to scientific evaluation. The ability of the patient to concentrate the urine, the amount of urine

excreted, and the absence of azotemia are the standards of measurement. In the questionable cases the determination of the urea clearance is of help In considering these factors it is important to take into account both the state of hydration and the nutritional status of the patient Should these be abnormal, the tests must be repeated after adequate therapy rather than to deny the patient the opportunity for surgery because of the absence of renal and cardiac reserve

PREOPERATIVE CARE

The preoperative period is employed to return the patient to a state of as nearly normal physiological and emotional equilibrium as the pathological anatomy of the organs will allow Primarily, all of the associated diseases are corrected Diabetes is brought under control with insulin, the cardiac arrhythmia controlled with the digitalis glycosides and quinidine and the retained fluids with diuretics.

Next the nutrition must be considered Most people of this age have finicky appetites and live on diets that suit their tastes but are entirely inadequate and unbalanced This not only creates actual deficiencies but also leaves the body reserves at dangerously low levels, possibly adequate for normal activity but insufficient for surgical purposes. With the added deficit in the protein balance which attends the operative procedure and postoperative immobilization, there may well be deficiencies in wound healing and obturating edemas of the mucous membranes in new surgical stomas A normal serum protein level is not sufficient reassurance in the evaluation of the protein deficiencies Evidences of muscle wasting or weakness are a far better guide, as the tissue protein levels are not correctly reflected in the state of the serum Balance studies are interesting in following the protein resurrection, but clinical observation usually will suffice Proteins are preferably administered orally in older people The veins must be preserved for other purposes and the time consumed in intravenous administration is most uncomfortable for these patients. Depleted vitamin stores must also be replenished, especially with vitamins C and B

Anemias are frequent in older people and their correction is most important to assure a smooth convalescence. The interpretation of the blood count must take into consideration the state of hydration of the patient Blood transfusions are the simplest method of correcting the anemia We feel, however, that frequent small transfusions are better tolerated than massive ones The patient frets at infusions of long duration and in many instances it is better to procrastinate rather than to rush the preparation.

During the period of preparation the patient should become accustomed to his surroundings and acquainted with the doctors and nurses who take care of him. We encourage our patients to leave their rooms for walks, or at least to visit the solarium. Exercise will prevent further protein loss. The whims of the patients are observed wherever possible. They are encouraged to follow their normal practices in the use of tobacco and alcohol. During this period an anesthetic evaluation is made and an anesthetic sequence chosen.

The intervention is timed when an effective maximum has been obtained in the physiological status of the patient. The blood count should be nearly normal, the blood proteins and chlorides at a level approaching the normal and the urinary output should be a liter a day containing 5 gm. of sodium chloride.

The caloric intake of the patient has been such that he is gaining weight and the protein intake sufficient to secure a positive balance, preferably 100 gm. a day by mouth or vein. Preoperatively certain exercises, including leg motions and deep breathing exercises, are taught the patient so that they may be more easily carried out in the postoperative period.

THE OPERATION

It will be noted from Tables 1 and 2 that almost all types of operations can be and have been carried out in older patients. In the operative period of their care, the anesthetic sequence is of great importance. The ideal is the anociation technic of Crile. Some patients, notably the toxic thyroids, are carried completely through the procedure by this method. In other patients an amnesia is attempted for the period with barbiturate sedation on the evening before operation, and a basal narcosis preoperatively. Combinations of various anesthetic and analgesic medications are preferred so that no large amounts of any medication are used. Combinations of inhalation and intravenous media, often further combined with conduction blocks and relaxation secured with curare derivatives, afford adequate anesthesia and a minimum of hypoxia. Continuous spinal anesthesia using a catheter in the subarachnoid space often helps in upper abdominal operations. Cyclopropane, except for thyroid cases, is preferred of the inhalation agents, as a maximum of oxygen is administered. On many occasions the intratracheal tube is most beneficial, as the edentulous jaw is difficult to control.

The operations in older patients differ from those in younger individuals. Here is no place for the surgical tyro, as dispatch and prompt decisive action will definitely reduce the mortality and morbidity.

The incision must be planned to afford a maximum of exposure so that tissue handling will be reduced to a minimum. This is especially important in abdominal operations The incision should expose the affected area well enough so that evisceration is avoided and packs are not necessary. Much packing with laparotomy sponges is definitely harmful. In the upper abdomen, we prefer the transverse or Singleton oblique incision In the lower abdomen the muscle splitting or midline suprapubic incisions are used These appear to afford the necessary exposure and may be relatively rapidly closed and are followed by a minimum of postoperative discomfort.

Gentleness in the handling of the tissues is more important in the older patient The vessels are exceedingly fragile and hematomas are frequent unless the tissues are handled tenderly. The wound must be closed carefully layer by layer to insure healing Mass ligatures are to be avoided and sutures are tied with tension but without strangling the tissues.

The choice of the operative procedure is, of course, a matter of individual judgment based upon experience. Often relative conservatism is demanded by the general status of the patient The minimum procedure affording the maximum of comfort commensurate with the level of preoperative evaluation is to be performed.

THE POSTOPERATIVE CARE

In the postoperative period it is important to anticipate any complications Pain amelioration is secured by the use of dolophine or morphine. The former is proving to be of value when the pain is only moderately severe After extensive surgery in patients with low pain thresholds, we have found that procaine given intravenously is of great value and avoids the side effects of large doses of morphine sulfate Sedation, in contrast to analgesia, is accomplished by the use of phenobarbital and bromides The more potent barbiturates are avoided since their action is apt to cause some disorientation in the aged

Exercises in bed– active and static—taught prior to operation are insisted upon and performed under the supervision of the residents and nurses In this immediate postoperative period abdominal distention is prevented by the judicious use of the Levin and Miller-Abbott tubes. It cannot be stressed too much how painful the insertion of these tubes may be if introduced by an untutored resident or intern This is especially true if there is present a deviation of the nasal septum or a chronic sinusitus. We have found that the application of a local anesthetic to the sensitive mucous membrane of the nose as well as the thorough

chilling and lubrication of the tube often permit its use with little discomfort even in the most difficult of patients. Often comfort can be achieved with the use of oxygen administered by the tent method. Deep respirations are achieved by deep breathing exercises and ventilation with carbon dioxide and air

The fluid intake and output must be watched with meticulous care, especially as to acid-base balance. This is checked by daily determinations of urine chlorides, as well as blood chlorides and alkali reserve estimations when indicated. It is often difficult to regulate the blood chlorides in the aged, especially in their immediate postoperative period. Often error is made by the administration of excessive amounts of saline solution. At the same time that the electrolytes are being controlled, blood depletion and hypoproteinemia are prevented by plasma and whole blood transfusions. Vitamins are added to these infusions as needed. This management insures proper wound healing and by the same token prevents the development of decubitus ulcers.

Because of the careful preoperative preparation and because of the careful approximation of the wound edges, we feel very safe in advocating early ambulation. The senior author in a paper in 1937 called attention to early ambulation and how necessary it is to older patients. Although all of the benefits of early ambulation are appreciated, we are particularly insistent upon it because we feel that it does return the patient to normal life in less time, however, our studies have given no definite evidence that it decreases thrombophlebitis to any appreciable extent.

At this point in the convalescence of the patient, the preoperative appraisal of his mental attitude pays dividends. We have explained to him what was planned, how it was to be done and what to expect. Now we must assure him that all went well in the operating room, that we accomplished our purpose and that we are optimistic about his future. The older patient needs encouragement, gentleness and understanding, which everyone of the hospital personnel gives to him. The nurses are taught to notice his little whims and to gratify them Above all it is essential that the attending staff as well as the nursing staff comprehend the importance psychologically to the patient of knowing that his complaints and fears are not only listened to but are fully appreciated. Elderly patients are very resentful of being given a "brush off" and brood over anything that might be interpreted as such. They are made to feel that all are deeply interested in his convalescence and problems.

As soon as possible after operation these patients are encouraged to eat Usually they are allowed to choose their food for the following day from daily menus given to them each evening. Once again their in-

dividual whims are catered to but at the same time strict attention is paid to an adequate diet, especially the protein intake. No matter what the diet may be it must be served in an attractive and appetizing manner

In spite of all advances and studies, the prognosis in elderly patients remains somewhat more guarded than in the younger age groups. This, however, should not be a deterrent to surgery necessary to insure not only comfortable days but active and happy hours to these older people.

THE PROSTATIC PATIENT: PREOPERATIVE APPRAISAL AND CARE

WILLIAM BAURYS, M.D., F.A.C.S.

IN a routine examination of aged patients, prostatic morbidity as the cause of obstruction is diagnosed frequently. The percentage of obstructive hypertrophy increases in direct ratio with advancing years; i e., the greater the age beyond 50, the greater the frequency of prostatism.

The process of tissue atrophy, the usual change accompanying senescence, is reversed in the prostate. We do not know the necessity of the prostate gland in the human economy, why nature produces conditions to cause hypertrophy in advancing years is also a mystery. It has never been proved that the tissue has endocrine, sexual, or any other essential function.

The adolescent prostate is small and rather flat. It does not pout into the rectum and the consistency is neither hard nor firm. Most men in their late thirties show beginning evidence of comparative enlargement as determined by the examining finger. This increase in size has no significance from the surgical standpoint. Even though somewhat larger than in the adolescent, it does not interfere with the free flow of urine. As the individual becomes older, hypertrophy becomes more perceptible and may become obstructive.

About 10 per cent of hypertrophies in men past 60 years of age require operative correction. In the preoperative care and appraisal we start with the determination of the type and degree of enlargement, and we also decide whether an operation is necessary.

The aging patient who presents symptoms of frequency and nocturia is not always a prostatic patient, but invariably this is the first impression Several deceptive conditions mislead the patient and, at times, the overzealous operator.

In our experience, we have found many of these older gentlemen obsessed with the idea that they have an enlargement of the prostate requiring surgical correction. This impression is occasioned by a newly experienced nocturia of one or two times and by the well-known prevalence of obstructive hypertrophy in this age group. As a result of such a

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combination of circumstances, an impressionistic individual might even develop a mental fixation along these lines

When careful examination reveals no evidence of significant obstruction, operation is not indicated In such instances the patient's mind must be set at ease This, of course, is not always an easy accomplishment Frequent examinations and reassurance will often place this individual at ease

Occasionally an aging patient will seek operation in order to avoid trouble in later years This attitude must also be corrected We have no way of foretelling that a prostate will become obstructive. At the present time there is no practical way of applying prophylaxis against obstructive hypertrophy

Following a routine examination by an attending physician, frequently a patient is referred to a urologist for a prostatic operation because a large prostate was discovered on rectal examination The urological study shows a good forceful stream with a satisfactory parabola and no residual urine is found In this type of case, the large amount of prostatic tissue noted by the examiner is so distributed as to cause no obstruction A large gland is not always an obstructive gland An enlargement requiring surgery is not determined by rectal palpation alone

EFFECT OF ALCOHOL

In the temperate climates, instances of urinary difficulties occur more frequently during the winter months It has also been noted that periods of alcoholic excesses will transform a threshold prostate into an obstructive one The writer recalls numerous instances in which a patient has had to be catheterized after a drinking party Following this incident the individual disappears and is not heard from until another drinking bout, with a repetition of his difficulty. The interval may be months or even years, depending on his behavior In between times, he is quite well from a urinary standpoint If his behavior has been good, he may never experience another obstruction.

Exposure to cold during the winter months probably cannot be controlled, but exposure to alcoholic drinks can be governed These patients should be admonished and the postalcoholic prostatic congestion explained to them Alcohol is one of the few drugs which is excreted by the prostate gland In such instances of obstruction, the urologist may temporize as far as operative correction is concerned; however, examinations at intervals are necessary Between alcoholic bouts the patient is very comfortable He has a fair parabola to the urinary stream, a nocturia of once or twice and no residual urine He may precipitate a neces-

sity for operation if he fails to heed advice about drinking, but, on the other hand, he may avoid this with prudent behavior.

CARCINOMATOUS PROSTATE

Not even every patient with a carcinoma of the prostate needs an immediate operation. Some individuals who, on routine examination, are found to have a hard fixed gland without evidence of serious obstruction may be entirely asymptomatic. Such cases require no immediate operative attention. Many of these carcinomatous prostates are slow growing and remain without producing subjective symptoms for years, and the patient may live a normal life time without any consciousness of the presence of this growth. Assuming that this process is beyond a stage amenable to radical perineal correction, no operative procedure is indicated in the asymptomatic prostatic carcinoma. These patients should be frequently examined for evidence of metastasis and difficulty in urination, and if they appear, therapy may be instituted. Transurethral resection, orchidectomy, or stilbestrol may then be used. Resection is certainly not indicated until obstruction occurs. No advantage has been demonstrated in the use of hormonal therapy before other than local objective symptoms are apparent Although this last statement is controversial, with our own present knowledge, experience and results we are justified in this attitude.

To encourage operation when required is very important. These men are all aged or aging and certainly it is unwise to wait since there is no other method of treating this impediment to the emptying of the bladder. On the other hand, the urologist should spare an aged patient an operation wherever possible.

In the preoperative appraisal, certainly a good bit of the examiner's time must be spent avoiding an unnecessary operation We should not rely too much on our present day low operative mortality if we wish to escape an occasional unexpected tragedy in instances where we do not properly respect the physical changes produced by senility.

PREOPERATIVE STUDIES

When, after proper examination and adequate observation, operation is considered essential, certain routine studies are prescribed. The candidate for surgery with bladder neck obstruction presents several problems, the most prominent of which are geriatric, cardiovascular and surgical About forty-eight to seventy-two hours in the hospital are required to make necessary preoperative studies. The present day success in the treatment of these patients is due to the proper recognition

combination of circumstances, an impressionistic individual might even develop a mental fixation along these lines.

When careful examination reveals no evidence of significant obstruction, operation is not indicated. In such instances the patient's mind must be set at ease. This, of course, is not always an easy accomplishment Frequent examinations and reassurance will often place this individual at ease.

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bearable irritation results, periodic catheterization and sedatives are employed instead. Proper rest must be insured.

Rather recently, we have been impressed with the merits of the silver catheter described by Dr Nels Ockerblad. The very popular latex Foley catheter is immersed in a strong silver nitrate solution for several days and the rubber is impregnated with the silver as evidenced by the dark discoloration. According to the reported experience of Dr. Ockerblad, the silver catheter is less irritating to the urethral mucous membrane and he reports that no postoperative strictures develop following its use. The method is very intriguing, however, our experience is too limited to offer any conclusions.

Diet.—Unless some complicating condition exists, a general diet is ordered. Where an achlorhydria interferes with a proper appetite, hydrochloric acid is used to correct it. The stimulating effect of alcoholic drinks on the appetite is well recognized and we entertain no objection *to a highball or two for the individual who customarily enjoys them.* Fluids are encouraged so that the urinary output is 1500 cc or more in twenty-four hours Coffee and tea are not restricted. The diabetics are treated with appropriate diet and insulin until their blood sugar reaches suitable limits. The laboratory is invaluable in the preoperative appraisal of our prostatic patients.

Laboratory Examination.—A Wasserman test is made routinely. If the report is positive, the stage of the disease and the systems involved are determined. When the history and examination show an early case, we first treat him with penicillin. Such cases require about ten days for satisfactory preparation. We administer 10 million units in divided doses over a period of nine days. Early syphilis occurs infrequently in this group.

If involvement of the central nervous system is noted, the degree and type is diagnosed. Fever therapy or other methods are first used to treat them before they are classed as satisfactory risks. In all cases where infection of the brain and spinal cord is demonstrated, we are on the alert *for the tabetic type of bladder which might offer a confusing picture with* its attendant atonic distension.

Where asymptomatic latent syphilis is present, we recognize no contraindication to prostatic surgery and we do not insist on preoperative antiluetic treatment.

Among our patients are paretics who at one time had been committed to a mental institution and had recovered following adequate therapy. These patients presented no particular difficulty either before or after operation.

In the evaluation of the blood count report, the number of red cells and the percentage of hemoglobin is of particular importance. Because of the vascularity of the prostate gland, we always anticipate considerabe bleeding regardless of the operative approach If the red cells are below 4,000,000 or if the hemoglobin is below 70 per cent, we order transfusion Where we are dealing with a large vascular type of gland, we keep two flasks of blood in readiness in the operating room

At operation, in an occasional case, the bleeding becomes alarming and difficult to control In such emergencies immediate transfusion might be live-saving Some of these patients go into shock quite readily

As long as we are satisfied that there is no blood dyscrasia, the white cell count offers no great concern The individual with a pyuria and a pyelocystitis will naturally have a high white count, but this does not interfere with operation

The blood sedimentation rate is determined but the result has little bearing on the operation The rate of sedimentation is regarded as giving some lead to the possibility of a malignancy in the prostate It has been reported that a normal curve supports a diagnosis of benign prostatic hypertrophy, whereas the second zone curve would suggest a malignancy without metastases and the very rapid sedimentation rate is found in malignancies with metastases This study has not proved to be very reliable in our hands

Blood urea nitrogen determinations are among the most important blood chemistry studies The degree of retention of nitrogenous waste products in the blood stream will provide information regarding the presence of serious renal impairment Lesser degrees of reduced kidney function will not be divulged by this particular blood chemistry determination We do not hesitate to operate on a patient even though his blood urea nitrogen is high When a patient is admitted with a marked renal deficiency, he is treated in order to improve his excretion as much as possible After the blood urea has reached a stable point, we consider it the optimum for the particular case In several instances, we have operated on patients with a urea of over 100 mg per 100 cc and the surgery was withstood satisfactorily Renal function improves after the obstruction has been removed

An indwelling catheter is placed during the period of treatment and the patient is given large amounts of fluids by mouth and parenterally A suprapubic drain is never required when preparing him in this manner. We feel that drainage per urethral catheter is satisfactory and the only instance where suprapubic cystostomy might be necessary is in that rare case where a catheter cannot be introduced per urethra

Alkaline and acid phosphatase studies are made routinely In some

instances, high acid phosphatase will be reported where only a benign gland is diagnosed preoperatively. Where the acid phosphatase is considerably above normal, we are invariably dealing with a malignant gland, however, the opposite of this is not true. Many of the malignant glands have normal blood phosphatase levels. Every malignant gland with bony metastasis will show an increase in blood phosphatase levels, on the other hand only about one third of the malignancies without bony metastasis will show phosphatase values above normal limits The most reliable means of diagnosing carcinoma of the prostate preoperatively is the examining finger.

Intravenous urograms are made routinely. We use Neo-Iopax in these studies. This has been an entirely safe procedure in our experience. Ordinarily no elaborate sensitivity tests are made. Our only precaution is observed when the drug is being administered. Two cc. are given and then a wait of three minutes is allowed during which time the patients are closely watched. If no reaction is observed, we continue with the other 18 cc. After the first 2 cc. are given about 2 per cent of the patients will complain of severe nausea, tightness in the chest, or other significant symptoms. This we accept as a signal to intercept further administration of the dye. In the other 98 per cent no untoward reactions are experienced. Many have a pain in the arm but this is not unbearable. A small percentage will develop a phlebitis in the vein through which the drug was administered. This results in a not too severe discomfort lasting only a few days.

In connection with this x-ray work, we examine the scout film and the intravenous study for calculi and evidences of metastases to the bones We also get a gross idea of kidney function. We know that the renal excretion is markedly reduced if we fail to note any dye excreted at the end of thirty minutes. Then we also learn about the presence of hydronephrosis or any other pyelographic distortion of the upper urinary tract. A hydronephrosis following a prolonged siege of bladder neck obstruction is not an infrequent observation and it clears up in most instances following the removal ofthe obstruction.

Almost all diverticula are demonstrable in the intravenous cystogram Other irregularities in the contour of the bladder are shown as well as the approximate size of the prostate. Unless some special indication makes it necessary we avoid examination with or passage of rigid instruments. Adequate information can be obtained from the intravenous studies and the instrumentation is quite uncomfortable during, as well as after, the procedure in a patient with an obstruction at the bladder neck.

Medications.—Certain medications are prescribed routinely during the preoperative care. Because of the recognized prevailing lack of

calcium in the diet and because of the frequent avitaminosis noted in this class of patients, calcium lactate and multiple vitamins are routinely ordered.

Sulfonamides are also given routinely during the period of preparation and preoperative study Many patients have infected urine on admission and many others will develop it from the indwelling catheter or from intermittent catheterization In those instances where there is no pyuria and where catheterization is unnecessary, this drug is given as a prophylactic One gram is administered four times per day after meals and before retiring A mixture of sulfadiazine and sulfamerazine is the preparation which we prefer Experiments have proven that such a mixture is more soluble and fewer serious reactions will occur as complications.

In about 15 per cent of instances sulfonamide medication must be interrupted because of various types of sensitivity to the drug Anorexia incident to sulfonamide medications at times becomes quite serious.

The more dangerous complications, such as anuria, rarely come on spontaneously Some premonitory warning symptoms will make their appearance to betray the approach of the more serious reactions Blepharitis and skin eruptions show an individual sensitivity that must be respected If the drug is not stopped, there is a progression to a more severe condition Headache and unexplained sustained fever are frequently occasioned by this type of medication These symptoms subside when the drug is discontinued Reduction of the urinary output below 1000 cc in twenty-four hours is another indication for stopping the sulfonamides

About 65 per cent of urinary tract infections are caused by the colon group of bacilli, either alone or in combination with other bacterial invaders In our experience, sulfonamides have been the best urinary antiseptics for treating these infections Where sulfonamides cannot be used or where the infection seems to be resistant our second choice is mandelic acid Because of a definite incompatibility between sulfonamides and acid medication of any type at least a twenty-four hour interval is permitted between the change from one drug to the other

Syrup ammonium mandelate, 2 drams four times a day, after meals and before retiring, is almost spectacular at times in clearing up a colon bacillus infection which has proved to be resistant to other treatment. Where a mixed infection is present, penicillin is administered concomitantly with either the sulfonamides or mandelic acid.

In our experience, streptomycin has been a rather poor urinary antiseptic. We have used it in twenty-six cases of urinary tract infections of various types This antibiotic has been administered only where it has

been indicated according to present day literature and only after other medication failed. We have seen only four cases that have been cured. Streptomycin certainly has no place in treatment of infections where the obstruction still persists or where an indwelling catheter is present.

The various proprietary preparations which color the urine are useful to a limited degree in alleviating irritation. According to our observation they have no antiseptic or bacteriostatic value.

We try to reduce a pyuria or eliminate it before operation; however, we do not delay operation because urosepsis persists. If there is an associated high febrile reaction, we delay operation until this subsides. When the temperature returns to normal, it signifies that the body has vaccinated itself against the invading organism and we do not hesitate to operate even though the infection persists Removal of the obstruction will help clear up the purulent urine.

SUMMARY

In the above discussion, we have attempted to describe the method we use in preparing our cases of prostatic obstruction for operation.

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ACUTE ABDOMINAL DISEASE IN THE AGED

WILLIAM C BECK, M.D., F.A.C.S.

WHEN one considers acute abdominal surgical lesions, one thinks of young patients. This is probably because appendicitis, salpingitis and perforated ulcer are diseases of youth and middle age, and are by far the most frequent cause of acute abdominal pain. On the other hand, diseases which cause acute distress are frequently the cause of hospital admission in the aged. Of 882 patients over the age of 65 admitted to the Guthrie Clinic in the years 1942 to 1947 with abdominal complaints, 193, or 21 per cent, could be classified as acute. The diagnostic problem in these elderly people is not the same as in younger patients because of the differences of the relative frequency of the disease states, the differences in the manifestation of the diseases, and somewhat in the modes of therapy. To evaluate these factors, we have undertaken a study of this series of patients, and have drawn certain conclusions from it.

In general our study revealed that patients in the older group came to the hospital far later than a similar group of young people. Families are often convinced that the older members must have pains and aches, and that these are of less significance than in young people. Moreover, they are often convinced that age itself is such a deterring factor that it is practically hopeless to ask for surgical aid. Thus often precious time is lost, and in the aged the time of intervention may be far more serious than in a young person who has a wide margin of cardiac and renal reserve. It is striking to note the concern on the part of the family who are asked to give permission for an emergency operative intervention on an old person. This apprehension is also often shared by the surgeon who knows the mortality statistics; and the statistics are probably higher than they should be for this very reason.

The relative frequency of the diseases which produce acute abdominal symptoms is analyzed in Table 1. It will be noted that this differs markedly from the conditions obtaining in younger individuals. Cholecystitis and its complications leads the list, if the cases of strangulated hernia are classified separately from those of bowel obstruction. Over 60 per cent of all of the patients, however, fall into these three diagnoses. Next in frequency is diverticulitis and its complications Appendicitis, and perforations and other complications of peptic ulcer, which in the

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young are so very frequent, are the least common of the major acute diseases of the aged We have no explanation for this, except that possibly most of the people who were predestined to get appendicitis have already had it by the time they reach advanced age Salpingitis and other acute gynecologic diseases are most uncommon.

TABLE 1

RELATIVE FREQUENCIES OF ACUTE DISEASES IN THE AGED*

	Number of Patients	Per Cent	Lived	Died	Mortality, per cent
Total series, acute cases	193	100	147	46	23 83
Acute cholecystitis	38	19 68	33	5	13 15
Perforated cholecystitis	7	4 62	4	3	42 85
Acute pancreatitis	1	52	1	0	0
Bowel obstruction	35	18 13	24	11	31 42
Strangulated hernia	34	17 6	30	4	11 7
Diverticulitis, simple	21	10 88	21	0	0
Perforated diverticulitis	12	6 21	5	7	58 3
Appendicitis	17	8 80	16	1	5 88
Mesenteric thrombosis	3	1 55	1	2	66 0
Bleeding marginal ulcer	4	2 07	4	0	0
Bleeding peptic ulcer	4	2 07	1	3	75 0
Perforated peptic ulcer	7	3 62	6	1	14 28
Perforated gastric cancer	2	1 03	1	1	50 00
Ruptured urinary bladder	1	52	0	1	100 0
Perforated cancer colon	4	2 07	0	4	100 0
Bleeding cancer stomach	2	1 03	0	2	100 0
Tuberculous peritonitis	1	52	0	1	100 0

* Taken from a series of patients seen at the Guthrie Clinic, 1942–1947

ACUTE CHOLECYSTITIS

Acute gallbladder disease in the aged is not too different from that of the young It is almost exclusively seen in women No age is respected, and it has been recorded in our series in a patient of 89 years In perusing the charts of patients with acute cholecystic disease one is struck by two facts The pain is usually far more diffuse than in younger individuals and often is centered considerably lower in the abdomen than is observed in the young. This may be due to the size of the liver in some instances (as, on several occasions of having operated upon these patients under the mistaken diagnosis of appendicitis, one finds the gallbladder lying almost beneath the McBurney-McArthur incision) The pain does not so characteristically radiate to the scapular area, and may in some patients radiate directly through to the region of the upper

lumbar vertebrae. The tenderness of the abdomen is rarely well defined and localized, and the muscle guarding may be quite diffuse. These physical findings which are diffuse are more prone to be observed early in the course of the disease than later when more definite signs usually supervene. Fever is often totally absent, and the leukocyte count is also completely unreliable.

The course of the acute process in the gallbladder is possibly more fulminating in the older patient. Rupture of the gallbladder occurs with greater frequency, and is less apt to recover spontaneously. Furthermore, rupture into the general peritoneal cavity without confinement to a localizing peritoneal abscess is more liable to occur. Of the seven cases of perforated cholecystitis, six were subjected to operation, and one was discovered only at the autopsy table. Of those celiotomized, only three showed an attempt at a walling-off process, and these were the three that recovered. Of the forty-six patients with acute gallbladder disease, seven (15.21 per cent) had perforated.

Calculi in the common bile duct are as frequent in the aged as in people in middle life. A history of jaundice should always indicate exploration of the duct. In many old patients the duct is quite prominent and relatively simple to open.

It is our conclusion that patients of advanced age with acute gallbladder disease should be given a trial of conservative therapy, but with much closer, and far more frequent observation than younger patients. The course of the fever and leukocytosis is of very little help in determining the progress of the disease or of its resolution. Unfortunately one must rely almost entirely upon the clinical sense, deprived of the aid of the laboratory. Any sudden and severe pain during the course of conservative therapy may be a warning that a perforation is taking place and that procrastination beyond this point may well be fatal. Perhaps the converse statement is better: that operation is indicated unless the patient perceptibly improves under conservative treatment.

The choice of the operation is entirely dependent upon the individual case So many complicating factors are active that one cannot be dogmatic in recommendations. Often a conservative procedure is all that the patient can withstand. In such an instance it may be possible to perform the excellent procedure of removing the mucosa of the gallbladder as recommended by Estes, or cauterize it as suggested by Pribram and by Thorek.

BOWEL OBSTRUCTION

In our cases we have differentiated sharply between acute obstruction and the subacute obstructions of the colon which are due to carcinomas

of the bowel The latter may often be relieved by enemas, and, with the use of chemotherapeutic and antibiotic agents, be prepared for operation without a decompressive procedure On the other hand the complete obstructions of the colon require a decompressive procedure Only the latter are considered in this report.

The diagnosis of the bowel obstruction in the older patient should not be too difficult if one keeps in mind that uremia may closely resemble bowel obstruction and yet that azotemia often accompanies an obstruction Far more difficult is the diagnosis of the cause and the site of the obstruction. In comparison with younger patients, the main difference appears to be that the colic is often not as severe, while the distention may be tremendous The x-ray of the abdomen appears somewhat more difficult of interpretation in the aged The ileocecal valve is more frequently incompetent, so that in colonic obstructions the ileum will *frequently contain gas The haustral markings are more difficult to* visualize so that small bowel distention is more difficult to differentiate from that of the colon. In such cases the barium enema is of real value

While it was frequently missed in the admitting room, femoral hernia was invariably discovered in the ward to be the cause of the obstruction The other causes of obstruction were more difficult of diagnosis. The one patient who had an obturation obstruction by a gallstone was not diagnosed until seen in the operating room The review of the skiagram did not disclose any gas in the biliary tract as demonstrated by Rigler. Volvulus of the sigmoid and of the cecal colon was recognizable in the x-ray film Mesenteric thrombosis was diagnosed in two of three instances, and, indeed one was saved by a massive bowel resection. The patients with mesenteric thrombosis were very ill, and the disease was insidious in its onset, with the signs of a diffuse peritonitis supervening upon the original signs of an incomplete bowel obstruction.

The indications for surgical intervention are those suggested by Koucky and Beck complete obstruction of the colon, strangulation obstruction and irreducible hernia Conservative therapy with a Miller-Abbott or Kantor tube was almost as well borne by our patients as by younger individuals We have used an additional indication in the older patient, patients whose colic has not been relieved by the section have been subjected to operation In most instances this rationale has been rewarded by finding a single adhesion band which so constricted the bowel that it was difficult to conceive of resolution by conservative means

In most instances the operation consisted in a procedure which relieved the obstruction, but we have in some produced a relieving stoma with an enterostomy as recommended by Guthrie. The operations were

usually carried out under spinal anesthesia, and in most instances this seemed to be ideal, where it was contraindicated, a combination of pentothal and inhalation anesthesia and curare appeared to be fully adequate.

Probably in no disease of the aged is the importance of adequate nutritional balance as necessary as in the bowel obstructions. It cannot be stressed too strongly that full hydration, protein and vitamin balance must be kept up parenterally. Vitamin K is often forgotten, yet hemorrhagic tendencies are not infrequent Kountz and Jorstad have much questioned early ambulation in these patients, but we feel that at least continuous, active and strenuous bed exercises should be carried out. Repeated studies of the alkali reserve and of the urinary nitrogen excretion are of real value in guiding the therapy. It must be remembered that the renal balance is often precarious and the reserve low, so that salt retention may be a real problem. Edemas in these individuals demand most careful evaluation.

STRANGULATED AND INCARCERATED HERNIA

The strangulated hernias of the aged have a somewhat sinister reputation because of a mortality which varies from 10 to 40 per cent. The mortality in our thirty-four cases was 11.76 per cent, which is a not inconsiderable rate. On the other hand, there have been patients 88 years old successfully operated upon for hernia. It is remarkable to find how long the patients have known of their hernias One of our patients, 79 years of age, had worn a truss for forty years.

An attempt at reduction by taxis is usually done first. It is attempted only if the pressure on the sac is not painful, and if the patient has not had any sedation for a period of three hours. Almost all of the hernias that contain a bloody fluid will be hard and tender, and the patient will not permit taxis For manipulation, placing the patient in a Trendelenburg position for fifteen minutes will often facilitate reduction. If this is unsuccessful, an emergency operation is performed

We use a combined anesthetic routine, with a field or intercostal block supplemented by pentothal and an inhalation medium, very small amounts of each being used. In the male with an inguinal hernia, we often if not usually remove the testis, thereby saving both time and securing a simpler repair. In the postoperative care we feel that early ambulation is of real benefit, and try to have the patient walk around his bed within the first twenty-four hours postoperatively. But this is not sufficient if the patient is out of bed for only a few minutes. Bed exercises are imperative, and the short walk imparts a false feeling of security

DIVERTICULITIS

One of the most frequent diseases of the aged is colonic diverticulitis and its complications It seems to replace appendicitis as the cause of so many of the acute inflammatory diseases of the abdomen in the aged The similarity between diverticulitis and appendicitis is an obvious one, as the vermiform appendix is, after all, a diverticulum of the cecum In all but one of the thirty-three patients in the series studied, the inflammatory lesion was situated in the area of the sigmoid colon One of them was situated in the cecum, and had perforated

Just as appendicitis has been described as having a classical clinical picture, yet so often baffles the most experienced clinician, just so does diverticulitis cause the examiner much difficulty in diagnosis The classical story is that of recurrent left lower abdominal pain, often associated with diarrhea and alternate constipation The pain of the presenting attack starts in the periumbilical area, but soon migrates to the left lower quadrant. The physical findings are, classically, the mirror image of appendicitis Yet in the aged the pain is often diffuse, and may be in either lower quadrant The prodromes of diarrhea are often wasting and anorexia, nausea and vomiting may be prominent. It may, indeed, be most difficult, if not impossible, to differentiate from acute appendicitis, and it may be necessary to explore the abdomen through a McBurney-McArthur incision to rule out appendicitis It is, also, occasionally most difficult to differentiate a perforated carcinoma of the rectosigmoid from an inflammatory lesion in the same area Foreign bodies may also lodge in the diverticula, in which case the x-ray examination may be most helpful We have seen both nails and lobster claws in diverticula

The therapy of diverticulitis in the aged is dependent upon the stage of the disease In the free perforations with a diffuse spreading peritonitis, the only possible treatment is immediate operation, exteriorization of the perforated segment, or a proximal colostomy In the localized processes or the nonperforated peridiverticulitides, conservative therapy is usually adequate This, in our hands, consists of a combination of absorbable and nonabsorbable sulfonamide medication We are at present using sulfacetamide and either sulfadiazine or combisul Most of the patients respond promptly to this therapy As soon as the acute process has subsided, the patient is studied with sigmoidoscopic and roentgen technics to rule out a neoplastic process

The prognosis in the perforated cases in the older patients is no better than in the young I have reported a series of patients with spreading peritonitis in younger patients which was routinely fatal With a localiz-

ing peritonitis, the prognosis is better. A temporary or permanent colostomy has saved some patients, but the mortality of this series with perforation was 58.3 per cent.

APPENDICITIS

In the old patient appendicitis is considered somewhat a rarity. Only 8 8 per cent of our series of acute cases were appendicitis. Operation was done in all but one, which was not found until autopsy. All of our patients had either a gangrene of the appendix or a perforation. This in some was not due to the rapidity of the process, but rather to the late arrival of the patient in the hospital. Yet appendicitis in the aged undoubtedly has a more fulminating course.

The diagnosis of appendicitis in the aged is not much more difficult than in younger individuals, except that localization is not as accurate. The oldest patient in this series was 79 All subjected to operation survived. We feel that the McBurney-McArthur incision is preferable.

PERFORATED PEPTIC ULCER

Perforation of peptic ulcers in the aged is not infrequent, yet the frequency is relatively much lower than in younger patients. Ulcers in the aged apparently have a greater tendency to perforate, as is suggested by Boles and Dunbar. These author found ninety-seven ulcers in 4000 autopsies in patients over 60 years of age. Of these, fourteen had perforated. In our series of seven perforations in patients over the age of 65, six patients were operated upon, one being *in extremis* on admission. All of the six subjected to operation survived. The oldest of these patients was 86 and he made a completely uneventful recovery.

The diagnosis of perforated peptic ulceration in the aged is not too different from that in younger individuals. The pain is usually sudden and agonizing, but the marked rigidity less. Bowel sounds were present in two cases. Younger people appear to have less tendency towards covering of the perforation by omentum, and we have recognized only one patient over 65 with a formes frustes type of perforation. All of our patients showed free air under the diaphragm which established the diagnosis.

In all of our patients the operative procedure was the same. We prefer a high right paramedian incision which may be quite short. The ulcer is sutured with either catgut or cotton through and through sutures, tying omentum into the knot after the method of Graham. Postoperatively, we keep the stomach as dry as possible for forty-eight hours with a Levin tube and suction. Ambulation is started on the third day, but bed exercises are started immediately.

If the perforation is a gastric one, or if it is impossible, because of the inflammatory reaction, to recognize the exact site of the perforation, a biopsy is taken. We have observed two cases of perforation of gastric carcinoma in this series The symptoms of the free perforation of gastric carcinoma are somewhat more mild than those of peptic ulceration, as the acids may be quite low. The dangers of the subsequent peritonitis are, however, much greater, so that if carcinoma is suspected we feel that massive doses of penicillin should be administered

MISCELLANEOUS ACUTE CONDITIONS

Many other of the more uncommon and rare diseases of younger individuals also occur in the aged We have one instance of tuberculous peritonitis in our series All of the abdominal traumatic lesions may be observed Rupture of the spleen is said to be more common in older individuals who are subjected to abdominal trauma, but in a series of fourteen cases of ruptured spleen from the Cook County Hospital, I have not seen any over the age of 65 Certain medical conditions are met with fair frequency in the differential diagnosis Aneurysms of the aorta, both saccular and dissecting, must be considered, as they may cause sudden and severe pain In these the differential diagnosis may be aided through the use of the abdominal scout film In the dissecting aneurysm, the finding of a hypertension is suggestive

COMMENT

Perhaps in no field of acute surgery is more judgment as well as tact necessary than in the aged. Many old people feel themselves beyond the age where surgical intervention is possible Often a fatality is viewed by the family as the product of overzealousness on the part of the surgeon It is also difficult to convince one's self that one is fair in recommending a serious operation on an old and infirm patient, especially if the patient already considers himself a burden to his family. Yet the salvage in happiness on returning such a patient to his family is a great one.

Evans and Key have called attention to the great importance of pandering to the whims of the aged, such as permitting them to smoke or use alcohol This, coupled with the maintenance of the nutritional state, active exercise (whether it be in the form of bed exercises or complete ambulation) and the use of fluids and blood, is the keystone of the care. As has been emphasized at the outset of this article, fluid and electrolyte replacement and correction of any anemia are problems of the postoperative period.

It, therefore, requires most careful observation of the clinical state of the patient and meticulous attention to aberrations in the laboratory studies. Review of the alkali reserve and repeated blood counts are invaluable. In the operative procedures, anesthesia must be so carried out that a minimum of hypoxia is produced. Moreover, most gentle handling of tissues will be rewarded with a smoother convalescence.

SUMMARY AND CONCLUSIONS

1. The relative frequency with which the various types of acute abdominal disease occur in the aged has been discussed, using as a basis the study of a series of 193 patients.

2. The more frequent diseases, gallbladder disease, bowel obstruction, incarcerated and strangulated hernia, diverticulitis, appendicitis and perforated peptic ulcer have been separately reviewed. The differences in the diagnosis and treatment between these diseases in the aged and in the young has been reviewed.

3. Conclusions have been drawn regarding the importance of the nutritional status, renal status and ambulation.

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THE MEDICAL RISK IN PATIENTS WITH TROCHANTERIC FRACTURES OF THE FEMUR TREATED BY INTERNAL FIXATION

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SINCE a large majority of the trochanteric fractures occur in patients over 60 years of age, it is only natural that serious associated diseases will greatly affect the prognosis in many cases. The occurrence of a serious femoral fracture with its attendant shock, pain and complete disability in a patient already debilitated by advanced age and by systemic disease is not infrequently sufficient to precipitate a fatal termination. However, efficient treatment of the fracture and prompt recognition and treatment of the associated diseases have resulted in a lower mortality in these cases. In this regard, it seems quite apparent that close cooperation between the internist and the orthopedist should be productive of the best results.

In recent years there has been an increasing number of trochanteric fractures treated by internal fixation rather than by continuous traction because of the improved results obtained by the operative method. The advantages of internal fixation are early relief of pain, early mobilization and ambulation of the patient, decreased number of urinary, pulmonary and joint complications, improved results in the fracture and a lower mortality rate. There is little doubt that following such fixation of the fracture these elderly patients can be treated in a manner which is much more conducive to recovery. The unfavorable effects of immobilizing such patients in traction or in casts have long been recognized. The benefits of the operation can be said to outweigh the added risk of the procedure, particularly if certain precautionary measures are taken. Here again the internist is called upon to judge the operability of the patient and to recommend therapy which will suitably prepare the patient for the operation and which will minimize the occurrence of postoperative complications.

In a recent paper[1] one of us has reviewed forty-five patients with trochanteric fractures of the femur treated by internal fixation from an orthopedic standpoint. It is the purpose of this paper to analyze the same group of patients, with the addition of fifteen more recent cases, from a

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medical standpoint. The incidence, type and management of serious coexisting disease and the effect of such disease upon the morbidity and mortality will be reviewed.

Between October 31, 1944 and February 1, 1948, sixty patients with sixty-one trochanteric fractures were treated by internal fixation The average age of these patients was 74, the youngest being 45, and the oldest 99 years of age Table 1 presents the age incidence by decades and shows that 87 per cent of the patients were 60 years of age or over The ratio of females to males was exactly 3 to 1 One patient had bilateral trochanteric fractures

TABLE 1

AGE INCIDENCE OF TROCHANTERIC FRACTURES IN DECADES

Decade	Number	Per Cent
40–49	2	3
50–59	6	10
60–69	10	17
70–79	18	30
80–89	22	37
90–99	2	3
Total	60	100

PREOPERATIVE MANAGEMENT

Immediately after admission to the hospital and after suitable x-ray films of the hip have been taken, the patient is placed in 8 pounds Russell traction This traction relieves most of the pain, reduces the vast majority of the fractures, but still allows frequent quarter turns of the patient, which is important in preventing pulmonary congestion and decubitus ulcers With the fracture under such control, a careful study of the patient is made All patients are seen by a medical consultant, and necessary preoperative therapy is begun for any associated disease and for the prevention of complications This preoperative preparation is carried out as rapidly as possible so that the operation is not unduly delayed As a rule the operation can be done within forty-eight hours of the patient's admission

Coexisting disease has not been a contraindication to operation in our patients It is our feeling that the advantages of operative fixation are even more definite in the case of the poor risk patient and that the procedure should most certainly be carried out if at all feasible.

From a cardiac standpoint, many of the patients were in very poor

condition. All of the older patients had variable grades of generalized arteriosclerosis. Forty-six patients (77 per cent) had demonstrable cardiac disease. Cardiac functional capacity* was graded in Class I in fifteen patients; Class II in sixteen cases; Class III in twelve, and Class IV in three cases. From this classification, it is apparent that in thirty-one cases (52 per cent) some degree of congestive heart failure was present. Twenty-seven of these patients were digitalized at some time during hospitalization. Twenty-six had clinically demonstrable cardiac enlargement; ten had evidence of aortic sclerosis and calcareous aortic stenosis; and sixteen had mitral insufficiency. Auricular fibrillation was noted in only three cases and extrasystolic arrhythmias were observed in seven. A history of angina pectoris was present in eight patients. The systolic blood pressure exceeded 150 mm. of mercury in thirty-nine instances, and diastolic pressure exceeded 90 mm. of mercury in thirty-four cases

In addition to cardiac defects, many of the patients had other associated conditions, fourteen patients had hypochromic anemia; nine had renal insufficiency; seven had diabetes mellitus; three, senile dementia; three, pernicious anemia (two of whom had combined degeneration of the spinal cord); three patients had old cerebral thromboses with hemiplegia; and many had variable degrees of obesity, dehydration and hypoproteinemia. Other diagnoses in single cases were bronchiectasis, asthma, multiple sclerosis, central nervous system syphilis and active duodenal ulcer. There were only five patients (8 per cent) who could be considered normal healthy individuals aside from their fractures.

The foregoing makes it apparent that medical appraisal of this type of orthopedic patient is essential. The cardiac and metabolic defects must be recognized and correction begun prior to an open reduction of the fractures. In our opinion nothing is sacrificed by delaying operation until a start can be made toward the control of these coexisting diseases, and this period of delay is time well spent as far as the patient's prognosis is concerned.

Many medical conditions may be present which will not interfere with the operative fixation of the fracture. However, there are a group of

* The New York Heart Association classification of patients with diseases of the heart:

Class I Patients with cardiac disease and no limitation of physical activities. Ordinary physical activity does not produce discomfort.

Class II. Patients with slight limitation of physical activity, who are comfortable at rest but develop symptoms with ordinary activity.

Class III. Patients with marked limitation, in whom symptoms develop with less than ordinary physical activities.

Class IV Patients who are unable to carry on any physical activity without discomfort. Symptoms of cardiac insufficiency are present even at rest.

diseases which will, unless controlled, definitely increase the operative risk and influence postoperative recovery Among such conditions are severe congestive heart failure, uncontrolled auricular fibrillation, uncontrolled diabetes, dehydration and severe grades of anemia We feel that these require preoperative attention, and it has been our custom to institute immediate measures to correct these abnormal states

THE OPERATION

Although the operation per se is not one of great magnitude, it is extensive enough when one considers the general condition of many of the patients For this reason and because of the many pitfalls incident to the internal fixation, the procedure should not be underestimated We have found that the patients do better if they receive a blood transfusion during operation

The patient is brought to the operating room in bed and in Russell traction, and manual traction is maintained while the patient is transferred to the operating table and during operation This part of the procedure is carried out with care so that the reduction of the fragments obtained by the preoperative traction is maintained and no manipulative reduction is as a rule necessary before or during the operation This step serves to reduce the amount of anesthesia required and to diminish the amount of operative trauma. The majority of cases need no or only slight operative adjustment of the position of the fragments when such a regimen is followed.

Since none of these patients is considered a good surgical risk, the choice of anesthesia is important Preoperative medication usually consists of 50 to 75 mg. of demerol and 0.3 mg of scopolamine Local anesthesia is used routinely and, as it is being injected, general anesthesia is induced with small amounts of a mixture of pentothal and d-tubocurarine given intravenously. Nitrous oxide and physiological amounts of oxygen are then administered. The local anesthesia greatly reduces the amount of the other anesthetic agents necessary, and the pentothal-curare mixture makes a light nitrous oxide anesthesia effective This combination has served admirably. It has an advantage of being nonexplosive, thus permitting the use of electrocoagulation for hemostasis The patient is usually awakening as the operation is finished. By using a combination of local, intravenous and inhalation anesthetic agents, it is possible to achieve a satisfactory anesthesia by the use of small amounts of each agent, thereby avoiding the depression usually produced if only one general anesthetic agent is used.

If desired, it is entirely possible to do most of the operation under local

anesthesia, except for the actual bone work which usually requires a small amount of inhalation anesthesia such as nitrous oxide and oxygen. Whatever anesthetic agent is used, these patients, for obvious reasons, should be awake soon after the procedure is completed.

The details of the operative procedure have been fully described in a recently published paper and are not essential to this discussion. Suffice it to say that the lateral subtrochanteric femoral cortex is exposed through a 6 inch lateral incision made from the tip of the greater trochanter downward. The exposure is extended so that the anterior aspect of the fragments is visualized. The reduction is verified. Under x-ray and visual control, a Smith-Petersen nail is inserted from a point one inch below the greater trochanter upward and inward through the neck and into the midpoint of the head of the femur. The inner end of the nail should not extend beyond this point so that intrusion of the nail into the hip joint will not occur as the fragments shorten in the healing phase. A Thornton plate is then attached to the head of the nail and to the shaft of the femur by a bolt and screws. In our experience the two component parts of this internal fixative agent have never unfastened with subsequent loss of fixation. The wound is then closed. The patient is placed in bed without any external splinting.

POSTOPERATIVE CARE

The patient is allowed bed freedom and change of position is accomplished every two hours. If necessary, the fluid intake is supplemented by intravenous therapy. The patient may be placed in a wheel chair at regular intervals, if the general conditions warrant this mobilization. Crutch walking without weight-bearing upon the involved extremity is allowed from two to three weeks after operation. Weight-bearing upon the fractured hip is not allowed until bony union is demonstrable in the roentgenograms, which occurs about four months postoperatively in the average case.

There are many patients who need the combined efforts of the orthopedist, internist, the nursing staff and dietitian to promote recovery. Anorexia is an almost constant problem and, if neglected, will lead to hypoproteinemia, poor wound healing, decubitus ulcers, anemia and weight loss. Special diets, supplemental amino acids and proteins and whole blood transfusions are most often used to compensate for a failure of proper food intake. Congestive heart failure and renal insufficiency demand daily supervision because a few days' neglect may be disastrous. Similarly, diabetes requires very careful management, since the trauma,

operation and enforced invalidism may seriously upset an otherwise easily controlled diabetes.

A number of the patients in this series were given dicumarol postoperatively to prevent venous thrombosis It has recently become our practice to use anticoagulants in a selected group, basing our selection upon the patients' reactions to the heparin tolerance test devised by de Takats [2] Although clinical proof of its applicability has not been established as yet, we have hoped that this test would help us choose those patients who would be most likely to develop intravascular thromboses and subsequent pulmonary emboli. In patients so treated, we have not observed untoward reactions or pulmonary infarctions We believe that the use of dicumarol is a worthwhile addition to the general medical and supportive management of this class of patients, even though the technic involves more careful observation of the patients and the necessity of frequent prothrombin time determinations

COMPLICATIONS

There were numerous complications that developed in those patients who survived Twelve patients developed pulmonary rales and were prevented from developing congestive heart failure by digitalization and the administration of mercurial diuretics Bronchopneumonia occurred in four patients and pulmonary embolism in one. Twelve patients developed urinary complications such as cystitis and incontinence, the latter frequently requiring an indwelling catheter to prevent decubitus ulcers. Cerebral complications such as mental confusion sufficient to interfere with optimum treatment occurred rather often If the hemoglobin fell to less than 65 per cent, whole blood transfusions were given Fifteen patients received 22 pints of blood after operation Only one patient developed thrombophlebitis of the saphenous system Acute parotitis was noted in one instance In spite of taking immediate measures for their prevention, seven patients developed decubitus ulcers These ulcers were treated variously, the most important points in management being the relief of pressure by mobilization and ambulation and active attention to diet, particulary protein supplements

RESULTS

Fifteen (25 per cent) of our patients died in the hospital A study of Table 2, which presents an analysis of the deaths, forcefully emphasizes the magnitude of the medical problems presented by this group of patients. The average age of those who died was 80 years, as compared to the average of 72 years of age for those who lived Of these fifteen patients, six died within the first two weeks postoperatively, four died

within the third and fourth weeks postoperatively, two died in the second postoperative month, and three died in the third postoperative month.

TABLE 2

ANALYSIS OF DEATHS

	Sex	Age	Cause of Death	Hospital Days	Days Postoperative	Comment
1	F	78	Congestive heart failure Hypertensive and arteriosclerotic heart disease with hypostatic pneumonia	88	86	Confusion and depression for weeks before admission, and progressively worse after injury with progressive debility and failure in spite of treatment. Unable to be out of bed.
2	F	86	Congestive heart failure Arteriosclerotic heart disease with coronary sclerosis and nephrosclerosis	33	31	Grade III congestive failure present on admission Progressed in spite of treatment
3	M	83	Arteriosclerotic heart disease with calcareous mitral insufficiency, severe anemia and nephrosclerosis with renal insufficiency.	28	27	Blood urea nitrogen 63 mg per 100 cc on admission Progressive lethargy and stupor Terminal multiple pulmonary emboli found at autopsy, and severe nephrosclerosis.
4	F	80	Arteriosclerotic heart disease with auricular fibrillation and congestive failure	7	3	Developed auricular fibrillation five days after admission (one day postoperatively), with uncontrollable left ventricular failure, and died two days later.
5	F	80	Hypertensive and arteriosclerotic heart disease with coronary insufficiency and probably coronary thrombosis	10	7	Uneventful course until twenty minutes before death, when she suddenly developed a choking sensation with pain in the left chest Admission ECG showed marked left axis deviation with evidence of chronic left ventricular strain
6	F	86	Hypertensive and arteriosclerotic heart disease with congestive failure, diabetes and renal insufficiency	22	19	Admission blood pressure 230/110 with generalized anasarca and senile dementia Kept alive by exceptional nursing care, but with ultimate gradual demise
7	M	81	Hypertensive and arteriosclerotic heart disease with congestive failure, diabetes and renal insufficiency	12	9	Dehydration, uncontrolled diabetes, congestive failure incontinence and disorientation Gradual failure after initial improvement
8	F	77	Calcareous mitral insufficiency with senile dementia, congestive failure and hypostatic pneumonia	29	25	Long history of senile dementia Unable to be ambulated because of this, and gradual failure in a bedridden state.
9	F	72	Calcareous aortic stenosis with congestive heart failure, renal insufficiency and diabetes	11	1	Extremely obese diabetic with initial blood sugar 343 mg per 100 cc and acidosis Diabetes controlled, but blood urea nitrogen soared to 219 mg. per 100 cc. Also hypertensive

operation and enforced invalidism may seriously upset an otherwise easily controlled diabetes.

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There were numerous complications that developed in those patients who survived Twelve patients developed pulmonary rales and were prevented from developing congestive heart failure by digitalization and the administration of mercurial diuretics Bronchopneumonia occurred in four patients and pulmonary embolism in one Twelve patients developed urinary complications such as cystitis and incontinence, the latter frequently requiring an indwelling catheter to prevent decubitus ulcers. Cerebral complications such as mental confusion sufficient to interfere with optimum treatment occurred rather often. If the hemoglobin fell to less than 65 per cent, whole blood transfusions were given Fifteen patients received 22 pints of blood after operation Only one patient developed thrombophlebitis of the saphenous system Acute parotitis was noted in one instance In spite of taking immediate measures for their prevention, seven patients developed decubitus ulcers. These ulcers were treated variously, the most important points in management being the relief of pressure by mobilization and ambulation and active attention to diet, particulary protein supplements.

RESULTS

Fifteen (25 per cent) of our patients died in the hospital. A study of Table 2, which presents an analysis of the deaths, forcefully emphasizes the magnitude of the medical problems presented by this group of patients. The average age of those who died was 80 years, as compared to the average of 72 years of age for those who lived Of these fifteen patients, six died within the first two weeks postoperatively, four died

It is apparent from these statistics that a patient with a trochanteric fracture treated by internal fixation has an excellent chance for a good result if the odds for survival are in his favor.

SUMMARY AND CONCLUSIONS

The prognosis in patients with trochanteric fractures of the femur depends to a great degree upon the medical risk involved. If these elderly patients can survive the hazards imposed by the fracture, its operative fixation and the early postoperative period, their chances of obtaining a good result are excellent. An analysis of this series of sixty patients suggests that the mortality can be minimized by adherence to the following principles of management:

1. Immediate control of pain and reduction of the fracture by traction.
2. Rapid medical evaluation and preparation of the patient.
3. Operative fixation as soon as the medical status of the patient permits
4. A wise choice of anesthesia.
5. The use of blood transfusions.
6. Rigid internal fixation which permits early mobilization and ambulation of the patient.
7. Continued medical supervision of the patient postoperatively.

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